NORTHUMBERLAND SEA FISHERIES COMMITTEE.

REPORT on the Scientific Investigations

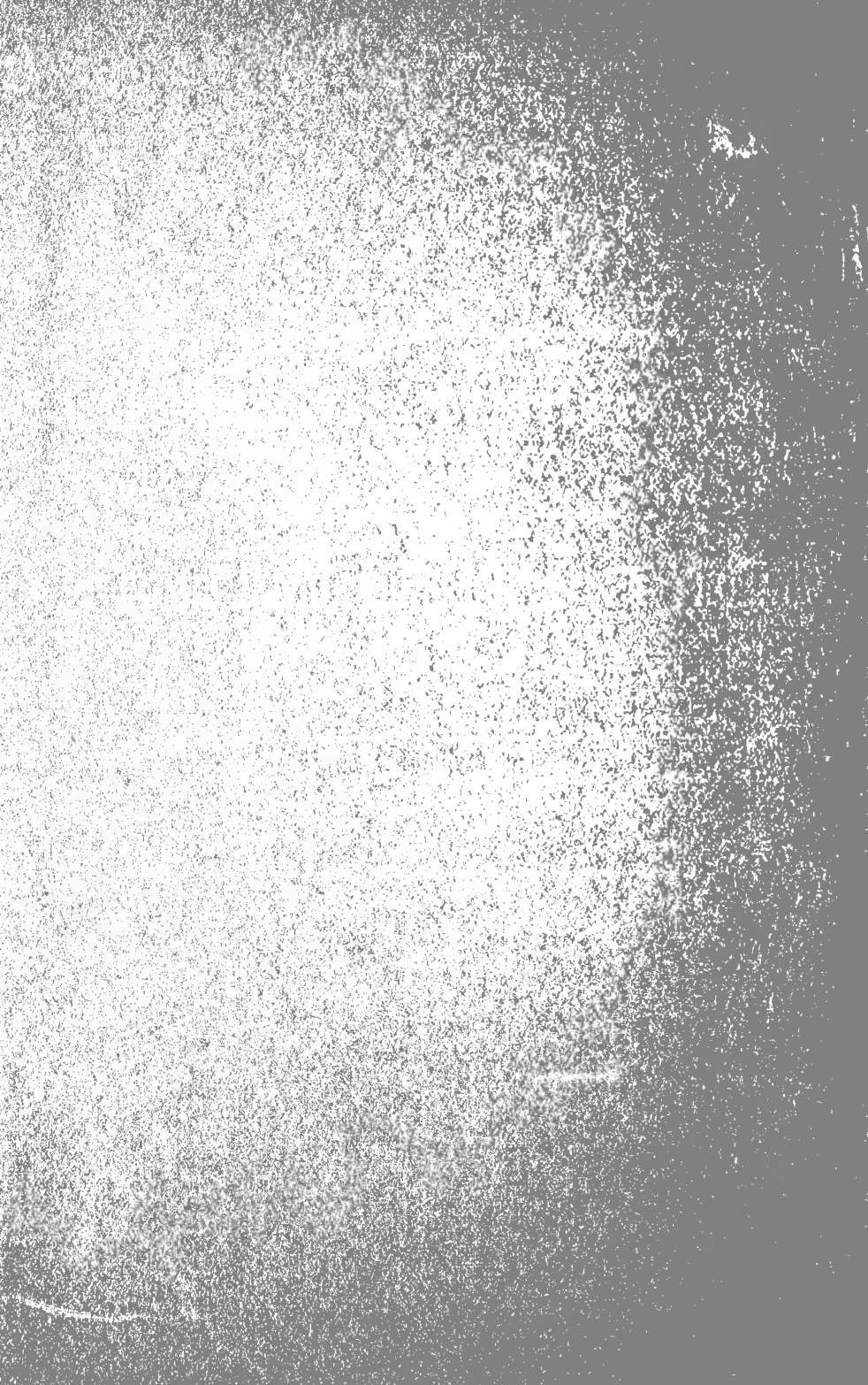
For the Year 1904.

EDITED BY ALEXANDER MEEK, M.Sc., F.Z.S.,

THE MARINE LABORATORY, CULLERCOATS, AND THE ARMSTRONG COLLEGE (IN THE UNIVERSITY OF DURHAM), NEWCASTLE-UPON-TYNE.

Printed by order of the Committee.

31ST DECEMBER, 1904.



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CONTENTS.

SUMMARY AND GENERAL REPORT.

I beg to submit the following report on the scientific investigations for the year 1904 :—

The Trawling Experiments were conducted as heretofore at the usual stations, and showed that the flat fish population has suffered a slight decrease in numbers. This, I regret to say, has also characterised both trawl and line fishing during the year. Cambois Bay was evidently during the summer in a very disappointing condition with regard to the important flat fish, and especially with regard to plaice. The other stations, however, do not depart materially from the satisfactory results of the last few years. Soles appear to be still fairly numerous in Cambois Bay, and have increased in numbers to a large extent at Skate Roads. There are signs that dabs are becoming less numerous in the district, particularly in the region north of the Coquet.

As before, tables are given showing the complete analysis of the first haul ; the food, sex and degree of maturity of the fishes ; and also with the help of Professor Brady, of the plankton of the surface and near the bottom at each station.

The large number of 468 flat fish, mainly dabs with a few flounders, plaice and turbot, were marked with labels and returned to the sea, and particulars are given as to the results of the experiments to the end of the year. These show that plaice do not usually migrate from the inshore waters until on the approach of maturity, when they are 4 to 5 years old. But instances are given of conspicuous migrations to the north. The (as yet) limited returns for dabs point to a segregation of the sexes, the females remaining in the inshore localities where they were liberated, and the males migrating 20 to 30 miles to the south and into deeper water.

The conferences with the fishermen, which are briefly referred to, indicated that many of the fishermen would welcome an attempt at lobster culture, and showed that an enquiry should be made without delay to see what could be done to improve the local supplies of mussel bait.

A detailed consideration of the crab and lobster fisheries of the district is presented, based on an analysis of the tables which have been contributed for a number of years by two of our local fisher-

men. It is shown that the catches of crabs are characterised by the large numbers of soft crabs or casters caught from September to January every year, and by the small numbers of berried crabs; that the lobsters taken by the fishermen include practically none that could be called soft, and that a great proportion of berried females are captured during the months when there is a close time in the district for their protection. Estimates are given of the proportions of the sexes, and of the spawn bearing females, from which it appears that the proportion of the berried to the unberried female lobsters is 1 to 2·25, and that the males are less numerous than the females. It is probable that the crab does not differ materially in this respect from the lobster. The crabs of the northern division of the county are often better in quality and far more numerous than those of the southern, and the reason is shown to be (with the aid of a map prepared by Professor Lebour) a geological one, the feeding grounds being so much more extensive in the former region. The more important facts from an economical point of view with regard to the life-histories are summarised, and the attempt is made to indicate the rate of growth. Attention is drawn, in estimating the population of both species, to the enormous death rate of lobsters and especially of crabs. The conclusions are (1) if further legislative interference is necessary for the improvement of the crab fisheries that a close time should be instituted for the months of October, November, and December, at a time when the fishery is most destructive, and when the catches include, it may almost be said consist of, the females which are about to come into spawn; and (2) that the only further legislative effort which can be made in the case of lobsters is to extend the protection to the berried female for the whole year; but seeing that already the local bye-law has created a great deal of friction, and has led in many cases to a habit of stripping off the berries on the part of fishermen who are determined not to make the sacrifice demanded of them, a constructive method of improvement should be adopted by establishing a centre for lobster culture in the district, at first, on an experimental scale. It being necessary, as the law is at present, to prove the removal of the shell-fish from the fishery district, even the legislation proposed would be greatly hampered, and might be found sometimes to be inoperative.

Miss M. V. Lebour, B.Sc., contributes a paper on a Trematode parasite of the Cockle, and adds a few species to our list of Marine Mollusca.

By the death of Principal Gurney, we have lost a friend who took the greatest interest in the fishery investigations we are conducting in connexion with the Natural History Department of the College and the Cullercoats Laboratory, which he opened in 1897. We have suffered another loss through the untimely end of E. P. Witten, B.Sc., who after a brilliant College career showed by his work, as will be seen by reference to my last two reports, great promise in the field of zoological research.

I regret to have to record that on March 28th a fire broke out in the Cullercoats Laboratory, and so serious was the damage that it brought the work conducted there entirely to an end. It meant not merely the destruction of most of our collections, of a great portion of our records, of valuable literature and apparatus belonging to the College, the Laboratory, and myself, but the total loss of the experiments which had been conducted for months with the object of obtaining as many facts as possible with regard to the growth of Crustacea, and the apparatus which had been procured for the purpose with the aid of a grant from the Royal Society. This laboratory we owed to the generosity of Ald. Dent, who has also given us the opportunities for conducting the experiments with reference to the white fishes of the district, and for obtaining much valuable material. It was conveniently situated, and attracted not only local workers, but investigators from a distance.

A committee of local noblemen and gentlemen has been formed with the object of reinstating the laboratory, and an appeal has been issued. The response, however, has not been so successful as the Committee desire, and we yet want the sum of £1,500 before we shall be in a position to build a laboratory worthy of the work and the district.

Alexander Meek.

THE TRAWLING EXPERIMENTS.

We have again to thank Ald. Dent, Chairman of the Committee, for the opportunity of conducting a series of trawling experiments, and of continuing the work of marking and returning to the sea large numbers of our inshore fishes with the object especially of determining their migrations. We have also to thank Mr. Saunders, Fishery Officer Taylor, and the crew of the "Stanley" for the valuable help they have given in making the records, and in marking the fish.

In view of the fact that a large amount of space is devoted to a consideration of the crab and lobster fisheries of the district, it is not proposed to treat the results of the trawling experiments at length. We hope that an early opportunity will be found to make a careful analysis of the "white" fisheries of the County, with the aid of the Government returns, and by bringing our experimental results strictly into line with one another. Meantime we simply present the results as heretofore, remarking as we have done before that the time given to each of the stations is very nearly the same every year.

Table I. exhibits the catches of marketable fishes, and Table II. the conditions under which the experiments were made.

TABLE I.

PLACE.	DATE.	Turbot.	Brill.	Sole.	Plaice.	Dab.	Flounder.	Total Flat Fishes.	Gurnard.	Skate.	TOTAL.
	1904.										
Cambois Bay	June 24th...	...	...	50	58	96	6	210	13	...	223
Blyth and Cambois Bays...	,, 30th ...	3	...	52	56	36	2	149	2	...	151
Druridge Bay	July 6th ...	10	1	37	199	93	...	340	17	...	357
Alnmouth Bay	,, 13th ...	1	...	24	320	31	30	406	2	...	408
Skate Roads	Aug. 1st ...	23	...	25	260	55	12	375	20	...	395
Druridge Bay	,, 10th ...	12	1	18	206	170	5	412	42	1	455
Blyth Bay	,, 17th ...	...	...	10	240	100	20	370	40	...	410
Cambois Bay	,, 24th ...	4	...	44	44	90	...	182	30	1	213
Alnmouth Bay	Sept. 7th ...	13	...	11	120	49	35	228	9	...	237

TABLE II.

Place.	Date.	Experiment.		Time.	Mid-day Temperature.		WIND.	SEA.	Weather.	Condition of Ground.
		Began.	Ended.		Air.	Water.				
	1904.									
Skate Roads ...	June 23rd ...	3·45 p.m.	4·50 p.m.	1 hour 5 mins.	...	...	N.W.	Smooth	Fine	Very much weed
Cambois Bay ...	,, 24th ...	noon.	7·30 ,,	7 ,, 30 ,,	60	52	Quiet, changeable	Do.	Heavy thunder storm in evening	Almost clean
Blyth Bay ...	,, 30th ...	9·5 a.m.	11·30 a.m.	2 ,, 25 ,,	...	52	E.	Moderate	Foggy	Much weed
Cambois Bay ...	,, 30th ...	2 p.m.	7·30 p.m.	5 ,, 30 ,,	...	52	E.	Do.	Do.	Clean
Druridge Bay ...	July 6th ...	10·25 a.m.	7·45 ,,	9 ,, 20 ,,	59	54	W.	Smooth	Fine, but squally, slight showers	A very little weed
Alnmouth Bay ...	,, 13th ...	11·10 ,,	7 ,,	7 ,, 50 ,,	66	55	S.E.	Moderate	Fine	Clean
Blyth Bay ...	,, 20th ...	9·15 ,,	10·10 a.m.	55 ,,	...	...	S.E.	Do.	Fine, cloudy	Much weed
Cambois Bay ...	,, 20th ...	10·45 ,,	5 p.m.	6 ,, 15 ,,	67	56	S.E.	Do.	Fine, cloudy, one shower	Almost clean
Skate Roads ...	Aug. 1st ...	5·30 ,,	3·30 ,,	10 ,,	75	57	W.S.W.	Smooth	Fine	Much weed
Druridge Bay ...	,, 10th ...	10·30 ,,	7 ,,	8 ,, 30 ,,	64	56	E.	Moderate	Showery	Much weed
Blyth Bay ...	,, 17th ...	9·20 ,,	7·30 ,,	10 ,, 10 ,,	60	56	N.W.	Do.	Do.	Clean
Cambois Bay ...	,, 24th ...	9·30 ,, 2·30 ,,	11·45 a.m. 7·15 ,,	6 ,, 15 ,,	62	56	N.	Rough	Stormy	Clean
Alnmouth Bay ...	Sept. 7th ...	11.5 ,,	6 p.m.	6 ,, 55 ,,	64	56	N.E.	Moderate	Fine, showers	Clean

The marketable flat fish averaged this year:—

Turbot.	Sole.	Plaice.	Dab.	Flat Fish.
7 ...	30 ...	167 ...	80 ...	297

These are not up to the figures of the last two years, but the averages are greater than those of any year previous to 1902 for the total flat fish; slightly higher for plaice, and for dabs for the same period with the exception of the years 1899 and 1900; higher for soles for all years except last year; the small return for turbot is about the average of all the years.

TABLE III.—The average catches of marketable flat fishes at each station.

Station.	No. of Experiments.	Turbot.	Brill.	Sole.	Plaice.	Dab.	Flounder.	Flat Fish.
Blyth Bay ...	1	...	...	10	240	100	20	370
Cambois Bay ...	2	2	...	47	51	93	3	196
Druridge Bay ...	2	11	1	27·5	202·5	131·5	2·5	376
Alnmouth Bay...	2	7	...	17·5	220	40	32·5	317
Skate Roads ...	1	23	...	25	260	55	12	375

It is in the case of Cambois Bay that the greatest amount of regression has occurred, especially with regard to plaice. The other stations indeed are continuing to furnish the enhanced numbers we have had to record for the last two or three years. To briefly particularize: Blyth Bay is slightly in excess of last year, and somewhat below 1902. Cambois Bay has decreased considerably in plaice, and in soles also, but only as compared with the large numbers of last year. Druridge Bay is worse as regards prime fish, slightly better in plaice, and shows a slight decrease in dabs. Alnmouth Bay has decidedly improved in plaice, but is worse as regards dabs. Skate Roads is evidently not so rich in plaice as last year, but is still in a very much better condition as compared with the preceding year.

The returns this year for Alnmouth Bay are interesting as showing a continuation of the tendency to become more like the northern part of the district in the proportions of the flat fishes.

DETAILED ANALYSIS OF THE FIRST HAUL.

For the first time we have this year made the measurements of the fish obtained at the first haul in centimetres instead of inches as heretofore. The change is to be welcomed for two reasons: it gives a more accurate analysis, and it brings our results more into line with those of other experimentalists.

TABLE IV.

CAMBOIS BAY, June 24th, 1904 (1 hour 15 minutes.)

CENTIMETRES.

	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Total.
Plaice ...	...	...	1	3	...	1	2	2	1	1	2	...	2	1	1	3	...	5	2	...	3	1	5	2	2	...	...	1	...	...	...	...	...	...	...	...	...	...	...	41
Dab ...	...	...	...	2	1	4	7	14	6	6	6	4	4	1	...	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	58
Turbot ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1
Sole ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	2	1	...	1	1	2	3	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12
Flounder...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2
Gurnard ...	...	...	1	...	2	...	2	5	3	4	3	1	...	...	1	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	24
Angler ...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	5*

*1 59 Centimetres. 143

BLYTH BAY, June 30th (1 hour 10 minutes.)

Plaice ...	...	...	...	...	...	...	...	1	1	...	1	...	1	...	2	4	2	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15
Dab ...	...	...	...	...	...	...	...	2	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3
Sole ...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	1	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5
Turbot ...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	2
Flounder...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2

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DRURIDGE BAY, July 6th (1 hour 5 minutes.)

Plaice ...	...	...	...	...	1	...	...	1	...	...	...	...	1	4	2	7	3	3	4	1	...	5	4	7	3	5	1	1	...	...	...	...	1	...	...	...	...	...	1	55
Dab ...	...	...	...	...	1	...	1	4	4	6	8	9	4	5	1	3	3	...	2	1	...	3	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	57
Turbot ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	2
Brill ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1
Sole ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	4
Flounder...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2
Gurnard ...	...	...	...	...	2	...	1	1	...	3	4	1	2	2	1	1	2	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	21

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TABLE IV.—Continued.

ALNMOUTH BAY, July 13th (1 hour.)

CENTIMETRES.

	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Total.
Plaice ...	...	...	...	1	1	1	3	4	...	1	...	...	1	2	2	4	1	...	1	...	...	1	1	1	...	3	1	2	...	1	...	...	...	...	...	...	...	...	...	32
Dab ...	...	...	...	...	...	3	3	3	2	2	2	1	...	...	1	...	1	...	1	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	21
Sole ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	1	1	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6
Flounder...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2
Angler ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	2	...	...	...	...	...	1	...	...	...	...	...	...	...	...	5*

* 1 Angler 87 Centimetres. 66

CAMBOIS BAY, July 20th (1 hour 5 minutes.)

Plaice ...	...	...	...	2	...	4	7	...	1	1	5	4	2	...	3	3	2	1	3	1	2	...	...	4	...	3	...	1	...	...	...	...	...	...	...	...	...	...	...	49
Dab ...	...	...	1	1	12	28	18	17	23	14	14	6	4	5	6	2	3	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	155
Flounder...	...	...	...	...	2	2	1	2	8	...	5	1	1	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	23
Whiting ...	...	...	...	...	...	...	2	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5
Angler ...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	...	4

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BLYTH BAY, July 20th (55 minutes.)

Plaice ...	...	...	...	...	...	2	2	1	1	...	3	3	3	5	4	3	4	2	4	2	1	1	...	1	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	44
Dab ...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2
Flounder...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	21
Brill ...	...	...	...	...	...	1	3	7	1	1	6	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1

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SKATE ROADS, August 1st (1 hour.)

Plaice ...	...	...	1	...	...	1	...	2	...	...	...	...	1	...	2	1	...	...	3	1	2	...	3	3	1	1	2	...	...	...	...	...	...	...	...	...	...	...	...	24
Dab ...	...	...	...	...	...	...	...	...	1	...	...	...	...	1	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4
Turbot ...	...	...	...	...	...	...	...	1	1	...	3	3	1	4	1	3	2	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	21
Flounder...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1

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TABLE IV.— CONTINUED.

DRURIDGE BAY, August 10th (1 hour.)

CENTIMETRES.

	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Total.
Plaice ...	...	...	...	...	...	...	...	...	1	...	...	1	1	1	...	3	2	5	3	...	5	2	1	1	6	3	1	...	2	...	...	1	...	...	...	...	...	...	...	39
Dab ...	...	...	...	...	...	...	7	7	9	9	10	13	4	4	1	4	4	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	74
Turbot ...	...	...	...	...	1	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...	1	...	...	...	...	...	...	...	6
Sole ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1
Flounder...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2
Gurnard ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	2
Angler ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2*

*1 54 and 1 55 Centimetres. 126

BLYTH BAY, August 17th (55 minutes.)

Plaice ...	...	...	1	1	1	...	...	1	...	3	...	...	...	4	4	7	7	8	7	4	3	2	2	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	57
Dab ...	...	...	1	...	...	2	4	8	4	4	7	5	3	2	1	...	1	3	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	46
Sole ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1
Flounder...	...	...	...	...	...	...	...	...	2	...	...	1	1	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7
Gurnard ...	1	...	...	...	...	...	5	1	6	3	...	3	5	...	3	...	2	...	...	1	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	33
Angler ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1

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CAMBOIS BAY, August 24th (1 hour.)

Plaice ...	...	...	1	...	...	2	...	1	1	...	1	2	...	...	1	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11
Dab ...	...	...	...	...	2	11	6	7	6	1	2	3	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	39
Sole ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	3	2	...	2	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	10
Gurnard ...	...	...	...	...	...	...	1	2	2	...	...	1	...	1	...	...	...	...	2	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10
Skate ...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1

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ALNMOUTH BAY, September 7th (1 hour.)

Plaice ...	...	...	5	4	4	1	...	...	...	1	...	...	1	2	1	1	1	3	2	4	4	3	1	1	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	41
Dab ...	...	...	...	...	...	...	4	2	10	6	7	3	4	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	37
Turbot ...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	4
Sole ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	2	2	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7
Flounder...	...	...	...	...	4	2	4	1	2	...	...	1	2	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	17
Gurnard ...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2

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FOOD, SEX, AND MATURITY.

In the following tables, which give the results of the examination of certain of the fishes captured at the trawling experiments, the measurements are in centimetres. The fishes of the inshore sandy bays were feeding this summer to a large extent upon sand eels.

The anglers were feeding also upon sand eels, and in some cases upon dabs, and whitings.

A sea trout, which was caught by Ald. Dent at Blyth, was found to contain 31 sand eels, measuring 7 to 9 cm.

TABE V.—PLAICE.

Date and Place.	Size.	Weight.	Sex.	Mature or Immature.	Size of Gen. Organ.	Food.	Remarks.
1904.	Cm.	Oz.			Cm.		
July 6th ... (Druridge)	40 × 24	26½	F.	—	6	*Donax trunculus*	.....
	33 × 19	15	M.	—	1·3	Small sand eels	.....
	28·5 × 18	9	M.	—	1	,, ,, ...	.....
	60·5 × 35	88	M.				
July 13th ... (Alnmouth)	40 × 25	27	F.	—	5	Small sand eels	.....
	33·5 × 21·5	18	F.	—	3·3	Empty	.....
	35 × 19·5	15	F.	—	2·9	Sand eels	.....
July 20th ... (Blyth)	25 × 19	14	F.	—	3·5	Sand eels	.....
	33 × 21	16	M.	—	1·5	,, ...	.....
	37 × 22·5	20	M.	—	2·5	,, ...	.....
Aug. 1st ... (Skate Roads)	44 × 26	35	F.	+	8	*Tellina tenuis*, *Donax trunculus*	.....
	39 × 23	24	F.	—	3	Empty	.....
	38 × 18	12	F.	—	2	,, ...	.....
Aug. 10th ... (Druridge)	46 × 27·5	36	M.	+	4	*Donax trunculus*	.....
	34 × 20	18	M.	—	1·5	Empty	.....
	28 × 16	10	F.	—	1·8	Sand eels	.....
Aug. 17th ... (Blyth)	36 × 22	20	M.	—	2·3	Sand eels	.....
	33 × 20·5	17	F.	—	3·3	,, ...	.....
	30 × 17	7	M.	—	4·5	,, ...	.....
Aug. 24th ... (Cambois)	29 × 18		M.	—	1	Empty	Too rough to weigh
	30 × 18		M.	—	1	,, ...	.....
	26 × 15		M.	—	·8	,, ...	.....
Sept. 7th ... (Alnmouth)	38 × 23·5	23	M.	—	2·5	Empty	.....
	30·5 × 18·5	14	M.	—	1	Sand eels	.....
	29 × 17	10	F.	—	3·5	Empty	.....

TABLE V. CONTINUED.—DAB.

Date and Place.	Size.	Weight.	Sex.	Mature or Immature	Size of Gen. Organ	Food.	Remarks.
1904.	Cm.	Oz.			Cm.		
July 6th ...	33×19	15·5	F.	+	5·3	Small sand eels	.....
(Druridge)	32×18	12	F.	+	4·5	,, ,, ...	.....
	27×15	9	F.	—	2·2	,, ,, ...	.....
July 13th ...	30·5×16·5	13	F.	—	5	Small sand eels	.....
(Alnmouth)	26×14·3	8	F.	—	2·5	,, ,, ...	.....
	23×12·5	6	F.	—	1·8	,, ,, ...	.....
July 20th ...	30×17	11	F.	—	2	Small sand eels	.....
(Blyth)	27×15	8	F.	—	4	,, ,, ...	.....
	22·5×12	5	F.	—	2	Empty	.....
Aug. 1st ...	36×20	24	F.	+	6	*Portunus holsatus*	.....,
(Skate Roads)	28×17	15	F.	—	4	,, ...	.....
	25×15	12	F.	—	2·5	,, ...	.....
Aug. 10th ...	31×18	14	F.	—	3·5	Sand eels	.....
(Druridge)	27×16	14	M.	—	1	Empty	.....
	22×12	6	F.	—	2	,, ...	.....
Aug. 17th ...	32×17·5	13	F.	—	3·5	*Portunus holsatus*	.....
(Blyth)	26×15	10	F.	—	2·5	Amphipods	.....
	27·5×15	9	F.	—	2·5	Empty	.....
Aug. 24th ...	33×18·5		F.	—	5	*Portunus holsatus*	.....
(Cambois)	32×17		F.	—	4·8	*P. holsatus* and sand eels ...	.....
	26·8×14·2		F.	—	3·5	Empty	.....
Sept. 7th ...	30×17	12	F.	—	4	Empty	.....
(Alnmouth)	28·5×15·5	9	F.	—	4·2	*Portunus holsatus*	.....
	24×13	6	F.	—	3	Annelid	.....

TABLE V. CONTINUED.—TURBOT.

Date and Place.	Size.	Weight.	Sex.	Mature or Immature.	Size of Gen. Organ.	Food.	Remarks.
1904.	Cm.	Oz.			Cm.		
July 6th ...	39×30	46	F.	—	4	Small sand eels	.....
(Druridge)	32×24	25·5	M.	—	3·2	,, ,, ...	.....
July 13th ...	34×26	34	M.	—	3	Small sand eels	.....
(Alnmouth)	22·5×18·5	11	F.	—	2·5	,, ,, ...	.....
July 20th ...	35×28	33	M.	—	3	Small sand eels	.....
(Blyth)	36×27·5	37	M.	—	3·5	,, ,, and lesser weever	.....
Aug. 1st ...	43×34	68	F.	—	7	Empty	.....
(Skate Roads)	36×26	32	F.	—	5	,, ...	.....
	32×25	28	M.	—	2·5	,, ...	.....
Aug. 10th ...	40×32	56	M.	+	4·5	Empty	.....
(Druridge)	37×27	40	F.	—	6	Sand eels, lesser weevers ...	.....
	32×25	30	F.	—	4	,, whiting	.....
Aug. 7th ...	25×19·5	14	F.	—	3	Sand eels	.....
(Blyth)							
Sept. 7th ...	40×32·5	52	F.	—	5·5	Whiting	.....
(Alnmouth)	38×31·5	48	F.	—	3	,, ...	.....
	37×26·5	42	M.	—	3	,, ...	.....

BRILL.

July 6th ...	48×32	53·5	M.	+	4	Empty	.....
(Druridge)							
July 20th ...	38·5×26	34	F.	+	8	Sand eels	.....
(Blyth)							

TABLE V. CONTINUED.—SOLE.

Date and Place.	Size.	Weight.	Sex.	Mature or Immature.	Size of Gen. Organ.	Food.	Remarks.
1904.	Cm.	Oz.			Cm.		
July 6th ... (Druridge)	30×12	7·5	F.	—	6·5	Empty	.....
	34×14·5	12	F.	+	12	Two small sand eels ...	.....
	46×21·5	34	F.	+	27	Annelid	.....
	50	44				Dab	.....
July 13th ... (Alnmouth)	34·5×14	17	F.	—	8·5	Sand eels	.....
	32·8×13	13	F.	—	8·2	,, ...	.....
	28·3×11·5	8	M.	—	1	Empty	.....
July 20th ... (Blyth)	34×15	15	F.	—	10	Empty	.....
	33·5×14·5	14	F.	—	8	Sand eel	.....
	28×12	7	F.	—	5	,, ...	.....
Aug. 1st ... (Skate Roads)	45×20	32	F.	+	21	Empty	.....
	32×15	18	F.	+	14	,, ...	.....
	28×11	12	F.	—	5·5	,, ...	.....
Aug. 10th ... (Druridge)	31×11	12	M.	—	1·2	Empty	.....
	24×10	8	M.	—	1	,, ...	.....
	23× 9·5	7	M.	—	1	,, ...	.....
Aug. 17th ... (Blyth)	45·5×22	35	F.	+	20·5	Empty	.....
	36·5×16	20	F.	+	14·5	,, ...	.....
	28·5×13	10	F.	—	6·5	,, ...	.....
Aug. 24th ... (Cambois)	46×19		F.	+	18	Sand eels	.....
	34×14		F.	—	10·5	Empty	.....
	28·5×11·5		F.	—	6·5	,, ...	.....
Sept. 7th ... (Alnmouth)	43·5×20·5	34	F.	+		Empty	.....
	35×15	16	F.	—	14	,, ...	.....
	30·5×14	12	F.	—	6	Annelid	.....

TABLE V. CONTINUED.—FLOUNDER.

Date and Place.	Size.	Weight.	Sex.	Mature or Immature.	Size of Gen. Grgan.	Food.	Remarks.
1904.	Cm.	Oz.			Cm.		
July 13th ...	31×16	14	F.	—	4	Sand eels	.....
(Alnmouth)	31·8×17·8	17	F.	+	6	,, ...	.....
	24×14	8	F.	—	4	,, ...	.....
July 20th ...	35×20	20	F.	—	7	Sand eels	.....
(Blyth)	23×13·5	6	F.	—	4	,, ...	.....
Aug. 1st ...	36×20	21	F.	+	8	*Tellina tenuis*	.....
(Skate Roads)							
Aug. 10th ...	31×18	17	F.	—	4·5	Whiting	.....
(Druridge)	27×17	13	F.	—	4	Sand eels	.....
Aug. 17th ...	32×17	16	F.	—	6	Empty	.....
(Blyth)	25·5×14·5	7	F.	—	4	Sand eels	.....
Sept. 7th ...	42×24	34	F.	+	7	*Tellina tenuis*, sand eels ...	.....
(Alnmouth)	30×18	11	F.	—	5·5	Empty	.....
	27·5×16	10	M.	+	3·5	,, ...	.....

GURNARD.

July 6th ...	32	9	F.	+	...	.....	.....
(Druridge)							
Aug. 1st ...	27	...			...	Sand eels	.....
(Skate Roads)	26	...			...	,, ...	.....
Aug. 10th ..	36	...	F.	+	...	Empty	.....
(Druridge)	30	...	F.	+	...	,, ...	.....
Aug. 17th ...	39	...	F.	+	...	Sand eels	.....
(Blyth)	33·5	...	M.		...	*Crangon vulgaris*	.....
	28	...	M.		...	Sand eels	.....
Aug. 24th ...	36·5	...	F.	+	...	*Crangon vulgaris*	.....
(Cambois)	33	...	F.	+	...	Whiting	.....
	27	..	F.	+	...	Sand eels	.....
Sept. 7th ...	34	...	F.	+	...	.....	.....
(Alnmouth)	25	...	M.		...	.....	.....
	23	...	M.		...	.....	.....

BIOLOGICAL INVESTIGATIONS.

Thanks to Ald. Dent, we obtained the use of the "Stanley" for dredging and surface netting off Blyth in May, and again at the annual excursion of the Northumberland Coast Club. A paper on the Crustacea obtained on the latter occasion has been prepared by Prof. G. S. Brady, and is to be published in the next number of the Transactions of the Northumberland Natural History Society. As before, the opportunity was taken at the trawling experiments to obtain samples of the surface and the bottom plankton—the latter by attaching a small net to the beam of the trawl. The general nature of the results is indicated in the following table. The Copepoda are in many cases detailed by Prof. Brady.

TABLE V.

Date and Place.	Apparatus, &c.	Organisms.
Inner Farnes ... June 23.	Net hanging in current	Ova of Weever, Larval Angler Copepoda: *** *Acartia clausii* *Temora longicornis* Barnacles: Cypris stage, cast cuticles ** *Euthemisto compressa* Spadella, Larval Polychæt Sarsia, Phiallidium
Pinnacles, Farnes June 23.	Net hanging in current	Ovum of Gurnard Copepoda: *** *Acartia clausii* *Temora longicornis* Barnacles: Cast cuticles *Pleopis polyphemoides* Young Polychæt
Cambois Bay ... June 24.	Surface net 6·15 to 7·30 p·m. 55 c.c.	Ova of Gurnard, Dab, Weever Copepoda: *Temora longicornis* *Pseudocalanus elongatus* *Oithona spinifrons* *Centropages hamatus* *Alteutha interrupta* *Acartia clausii* *Calanus helgolandicus* *Pleopis polyphemoides* *Euthemisto compressa* ** Barnacles: Cypris stage, cast cuticles Nauplius, Zoea stages Veligers Sagitta, Tubicolous Annelid, Larval Polychæt Phiallidium, Sarsia Pleurobrachia

Date and Place.	Apparatus, &c.	Organisms.
Druridge Bay ... July 6.	Surface net 12 to 1·30 p.m.	Ova of Gurnard, young gadoids Copepoda: **** *Centropages hamatus* *Oithona spinifrons* *Acartia clausii* *Temora longicornis* Ostracoda Barnacles: Nauplius and cypris stages, cast cuticles Nauplius, Zoea stages Appendicularia Veligers Young Pelecypod Larval Polychæt Sagitta Sarsia
Druridge Bay ... July 6.	Small net on beam 11·45 a.m. to 1·30 p.m.	Copepoda: Barnacles: Cypris stage, cast cuticles Sarsia
Alnmouth Bay ... July 13.	Surface net 5·20 to 7 p.m.	Ova of Weever Copepoda: *** *Acartia clausii* Ostracoda *Euthemisto compressa* Zoea Appendicularia Phiallidium
Alnmouth Bay ... July 13.	Small net on beam 3·45 to 5·10 p.m. 2 c.c.	Copepoda: *** *Acartia clausii* Barnacles, Cypris stage Young Pelecypod Young Anomia? *Ceratium tripos*
Cambois Bay ... July 20.	Surface net 1·55 to 3·45 p.m. 10 c.c.	Copepoda: *Acartia clausii* Caligus Barnacles: Cast cuticles Zoea, Megalopa
Cambois Bay ... July 20.	Small net on beam 4 to 5 p.m. ½ c.c.	Copepoda, *Acartia clausii* Barnacles: Cypris stage
Skate Roads ... Aug. 1.	Surface net 2·30 to 3·30 p.m. ½ c.c.	Ova, Weever Zoea, Megalopa stages Appendicularia Veligers
Skate Roads ... Aug. 1.	Small net on beam 12·35 to 1·50 p.m. 5 c.c.	Copepoda: *** *Temora longicornis* *Acartia clausii* *Centropages hamatus* Cladocera: *Evadne nordmanni* *Pleopis polyphemoides* *Gammarus locusta* Sagitta Veligers Cyphonautes stage

Date and Place.	Apparatus, &c.	Organisms.
Druridge Bay ... Aug. 10.	Surface net 3 to 4·15 p.m. 5 c.c.	Ova of Weever Copepoda: ** *Acartia clausii* *Temora longicornis* *Centropages hamatus* Cladocera: *** *Evadne nordmanni* *Pleopis polyphemoides* Ostracoda Appendicularia ** Veligers Larval Polychæts *Ceratium tripos*
Druridge Bay ... Aug. 10.	Small net on beam 3 to 4·15 p.m. 5 c.c.	Ova of Weever ** Copepoda: Almost absent Zoea, Megalopa stages *Ophiura albida* Medusoids ** Weed debris
Blyth Bay ... Aug. 17.	Surface net 3 to 4 p.m.	Ova of Weever ** *Copepoda* Porasitic Copepoda *Caligus rapax* Barnacles: Cast cuticles Megalopa stage *Ceratium tripos*
Cambois Bay ... Aug. 24.	Surface net 5 to 6 p.m. 90 c.c.	Ovum of Weever Young Pleuronectid and other fishes Copepoda ** Zoea and Megalopa ** stages Young Decapod *Idothea balthica* Sagitta Pleurobrachia ***
Cambois Bay ... Aug. 24. ...	Small net on 6 to 7·15 p.m. 130 c.c.	Ova of Weever Copepoda *** *Temora longicornis* *Centropages hamatus* *Acartia clausii* Barnacles: Cast cuticles Zoea Young Gasteropods Young Starfish Larval Polychæt Sagitta Pleurobrachia
Alnmouth Bay ... Sept. 7.	Surface net 2·55 to 4 p.m 80 c.c.	Copepoda * Megalopa stages ** *Euthemisto compressa* Lobster, 20 mm. Veligers Pleurobrachia ***
Alnmouth Bay ... Sept. 7. ...	Small net on beam 2·55 to 4 p.m.	Copepoda: Zoea Barnacles: Cast cuticles Larval Polycæt Sagitta Pleurobrachia *** *Ceratium tripos*

THE CRAB AND LOBSTER FISHERIES OF NORTHUMBERLAND.

By A. MEEK, M.Sc.

CONTENTS.

Under the heading "Crabs and Lobsters," I have published in previous reports details of the catches of crabs and lobsters made by Mr. J. Douglas, Beadnell, and Mr. G. Fawcus, Sea Houses. These two fishermen have taken great pains to furnish a faithful record of the nature of their captures, and as this has been done each year since 1899, we have for a period of six years a unique and interesting assemblage of figures bearing on the most important of our in-shore fisheries, and therefore deserving careful study and analysis.

This I have attempted in the following paper, and I take the opportunity to make a more complete statement with regard to these fisheries than has hitherto been possible.

Tables I. and II. set forth the information furnished by Mr. Douglas and by Mr. Fawcus for 1904.

TABLES SHOWING THE CATCHES OF CRABS AND LOBSTERS FOR 1904.

TABLE I.—BY MR. J. DOUGLAS, BEADNELL.

CRABS.

	January.	February.	March.	April.	May.	June.
Depth in Fathoms...	... 28 ...	... 28 ...	... 20 ...	... 16 ...	... 10 ...	3 to 10
No. of Pots...	.. 100 ...	... 100 ...	... 150 ...	... 250 ...	... 250 ...	... 250 ...
Dates.	Numbers.	Numbers.	Numbers.	Numbers.	Numbers.	Numbers.
1st ...	...	...	...	120	160	60
2nd ...	...	...	...	...	98	54
3rd ...	...	...	...	318	...	20
4th ...	...	...	100	60	120	68
5th ..	...	...	200	...	138	20
6th ...	...	...	...	330	...	70
7th ...	...	...	...	60	248	...
8th ...	...	180	...	128	90	76
9th ...	...	..	400	330	86	20
10th ...	...	...	240	...	...	50
11th ...	300	...	280	180	40	...
12th ...	200	400	160	...	47	...
13th ...	160	...	...	...	100	18
14th ...	...	...	300	...	21	...
15th ...	...	600	200	...	34	80
16th ...	...	100	300	...	22	...
17th ...	...	200	...	...	...	...
18th ...	500	...	200	...	80	...
19th ...	100	200	100	...	62	100
20th ...	200	100	...	178	68	120
21st ...	200	...	100	...	100	...
22nd ...	300	...	...	320	20	128
23rd ...	280	500	200	428	28	60
24th ...	...	360	100	100	...	20
25th ..	500	300	200	108	60	70
26th ...	...	...	400	...	28	60
27th ...	...	440	...	130	30	48
28th ...	...	...	400	86	34	...
29th ...	480	240	...	168	21	...
30th ...	...	...	100	160	40	...
31st ..	...	...	40		...	...
	Days. Numbers.	Days. Numbers.	Days. Numbers.	Days. Numbers.	Days. Numbers.	Days. Numbers
TOTALS ...	11 3,220	12 3,620	19 4,020	17 3,204	25 1,775	19 1,142
Average per day ...	293	302	212	188	71	60

TABLE I. (CONTINUED.)—CRABS.

DETAILS OF JANUARY CATCHES.		
January.	Males.	Females.
11th ...	160	140
12th ...	100	100
13th ...	70	90
18th ...	260	240
19th ...	40	60
20th ...	140	60
21st ...	130	70
22nd ...	200	100
23rd ...	150	130
25th ...	300	200
29th ...	280	200
TOTALS ...	1,830	1,390

LOBSTERS.

	April.	May.	June.
Number of Pots	250	250	250
Number of Lobsters	129	749	197
Number of Berried Lobsters ...	9	114	54
Number of Small	5	44	31

TABLE II.—By Mr. G. FAWCUS, Sea Houses.

CRABS.

Date. 1904.	Number of Pots.	Number of Males.	Number of Females.	Number of Berried Females.	Total Number of Hard.	Number of Soft.	Depth in Fathoms.
Jan. 21	50	20	18	...	38	4	20
23	50	30	40	...	70	7	,,
25	100	40	46	...	86	40	20 to 26
29	100	64	72	...	136	34	,,
4 days	...	154	176	...	330	85	...
Average	per day	38	44		82	21	
Feb. 15	100	30	20	...	50	10	20 to 26
17	100	50	40	...	90	20	,,
19	100	80	70	...	150	18	,,
22	100	30	45	...	75	24	,,
24	100	32	41	...	73	4	,,
27	100	10	200	...	210	8	,,
29	100	30	60	...	90	4	,,
7 days	...	262	476	...	738	88	...
Average	per day	37	68		105	13	
Mar. 8	100	42	71	...	113	6	20 to 26
10	100	35	42	..	77	3	,,
12	100	32	51	...	83	2	,,
15	117	80	100	...	180	8	6 to 26
16	117	60	110	...	170	9	,,
18	117	42	91	...	133	12	,,
21	117	32	104	1	137	8	,,
23	117	21	96	...	117	6	,,
25	117	10	80	...	90	3	,,
26	117	19	92	1	112	7	,,
28	117	14	106	...	120	2	,,
30	117	24	85	...	109	3	,,
12 days	...	411	1028	2	1441	69	...
Average	per day	34	86		120	6	

TABLE II. (CONTINUED.)—CRABS.

Date. 1904.	Number of Pots.	Number of Males.	Number of Females.	Number of Berried Females.	Total Number of Hard.	Number of Soft.	Depth in Fathoms.
April 1	117	9	64	...	73	1	6 to 26
4	117	12	72	...	84	5	6 to 16
6	117	21	65	...	86	7	,,
8	117	14	74	...	88	3	,,
11	117	10	60	...	70	5	,,
12	117	15	85	...	100	2	,,
13	117	18	48	...	66	8	,,
15	117	13	72	...	85	3	,,
16	117	24	93	1	118	4	,,
18	160	80	100	...	180	2	,,
19	160	18	28	...	46	1	,,
20	160	14	32	...	46	3	,,
21	160	8	20	...	28	4	,,
22	160	10	25	...	35	6	,,
23	160	4	21	...	25	1	,,
26	160	7	31	...	38	...	,,
27	160	9	11	...	20	...	,,
28	160	6	15	...	21	...	,,
29	160	15	34	...	49	2	6 to 12
30	160	14	16	...	30	1	,,
20 days	...	321	966	1	1288	58	...
Average	per day	16	48		64	3	
May 3	160	20	28	...	48	...	6 to 12
4	160	29	43	...	72	1	,,
5	160	64	73	1	138	2	,,
6	160	71	85	1	157	1	,,
9	160	52	43	1	96	3	,,
10	160	100	145	...	245	2	,,
11	160	84	73	...	157	...	,,
12	160	102	65	...	167	1	,,
13	160	94	63	...	157	...	,,
14	160	80	71	...	151	2	,,
16	160	62	83	...	145	4	,,
17	160	24	61	...	85	...	,,
18	160	21	42	...	63	2	,,
19	160	42	63	...	105	4	,,
20	160	80	100	...	180	3	,,
21	160	50	70	...	120	1	,,
23	160	60	65	1	126	2	,,
24	160	54	43	...	97	3	,,
25	160	31	24	1	56	1	,,
26	160	18	12	1	31	4	,,
27	160	32	28	...	60	3	,,
28	160	26	30	...	56	1	,,
30	160	28	36	1	65	2	,,
31	160	18	16	...	34	1	,,
24 days	...	1242	1362	7	2611	43	...
Average	per day	52	57		109	2	
June 1	160	12	24	...	36	4	6 to 12
2	160	16	21	...	37	...	,,
3	160	18	12	1	31	...	,,
4	160	15	13	1	29	2	,,
4 days	...	61	70	2	133	6	...
Average	per day	15	18		33	1	

TABLE II. (CONTINUED.)--LOBSTERS.

Date. 1904.	Number of Pots.	Number of Males.	Number of Females.	Number of Berried Females.	Total Number.	Depth in Fathoms.
Jan. 21	50	1	...	...	1	20
30	19	1	...	...	1	3
2 days	...	2	...	...	2	...
Feb. 16	17	2	...	...	2	6
17	17	5	4	...	9	,,
19	17	3	2	1	6	,,
20	17	4	2	1	7	,,
23	17	2	5	...	7	,,
24	17	3	3	...	6	,,
25	17	2	4	...	6	,,
7 days	...	21	20	2	43	...
Mar. 12	17	3	2	...	5	6
15	117	3	3	...	6	6 to 26
16	117	4	3	...	7	6 to 22
18	117	2	2	...	4	,,
21	117	4	3	...	7	,,
23	117	2	6	1	9	,,
25	117	6	4	...	10	,,
26	117	2	5	.	7	,,
28	117	3	3	1	7	,,
30	117	2	1	...	3	,,
10 days	...	31	32	2	65	...
April 1	117	2	...	...	2	6 to 22
4	117	5	3	2	10	6 to 16
6	117	4	5	...	9	,,
8	117	3	4	1	8	,,
11	117	4	6	2	12	,,
12	117	5	3	2	10	,,
13	117	6	3	1	10	,,
15	117	3	3	...	6	,,
16	117	4	3	...	7	,,
18	160	12	15	3	30	,,
19	160	8	12	4	24	,,
20	160	9	13	6	28	,,
21	160	7	12	7	26	,,
22	160	5	8	6	19	,,
23	160	8	16	5	29	,,
26	160	12	13	4	29	,,
27	160	4	8	3	15	,,
28	160	4	5	4	13	,,
29	160	6	8	3	17	,,
30	160	5	7	4	16	,,
20 days	...	116	147	57	320	...

TABLE II. (CONTINUED.)—LOBSTERS.

Date. 1904.	Number of Pots.	Number of Males.	Number of Females.	Number of Berried Females.	Total Number.	Depth in Fathoms.
May 3	160	4	6	3	13	6 to 12
4	160	5	8	2	15	,,
5	160	6	4	5	15	,,
6	160	5	6	2	13	,,
9	160	1	...	3	4	,,
10	160	8	7	5	20	,,
11	160	6	6	2	14	,,
12	160	3	2	1	6	,,
13	160	7	5	...	12	,,
14	160	4	4	1	9	,,
16	160	3	3	2	8	,,
17	160	5	7	4	16	,,
18	160	2	4	3	9	,,
19	160	5	3	6	14	,,
20	160	6	7	5	18	,,
21	160	3	...	3	6	,,
23	160	2	3	4	9	,,
24	160	1	2	6	9	,,
25	160	2	2	2	6	,,
26	160	5	3	4	12	,,
27	160	6	4	4	14	,,
28	160	3	4	2	9	,,
30	160	5	3	4	12	,,
31	160	2	1	3	6	,,
24 days	..	99	94	76	269	...
June 1	160	3	4	5	12	6 to 12
2	160	2	3	2	7	,,
3	160	4	4	1	9	,,
4	160	1	4	3	8	,,
4 days	...	10	15	11	36	...

1.—PROPORTIONAL NUMBERS OF HARD, SOFT, AND BERRIED.—

The results for the past six years are brought together in Table III. to show the numbers caught each month of hard, soft, and berried crabs, and of hard, small, and berried lobsters. The predominance of the crab, the large number of soft, the remarkably small number of berried of this species, are at once clearly contrasted with the inferior captures of lobsters, the practical non-appearance of the soft lobster in the catches, and the large number of berried lobsters caught especially in the months when the crab-pots are close in-shore. These features are rendered still clearer when the results are arranged to show the percentage relationships as in Table IV.

From Table IV. Charts I. and II. have been prepared. The charts represent the percentages of the totals at Sea Houses, and the Beadnell results are shown by the smaller columns in Chart II. In Chart I. the black portion of the column exhibits the catch of hard crabs in each case, the clear portion the soft, and to the right the small proportion of berried females is indicated by a small space enclosing horizontal lines. In the case of Chart II. the hard lobsters are shown by heavy lines, the males being defined on the left by small vertical lines and the females by the clear portion. The berried females are indicated thus :—ooooo.

Crabs.—Chart I. shows that the proportion of the hard and soft crabs varies in an interesting manner in the succession of months throughout the year, and that when the results are thus brought side by side, the relationship runs into an S-shaped curve. Soft crabs are caught all the year. Relatively few occur in the early part of the year and the spring; the numbers of soft crabs increase rapidly in the autumn, reach a maximum in October and November, and decrease almost as quickly during December and January. Our figures do not extend to the months when the soft crabs are particularly abundant, for the two fishermen to whom we owe the tables are amongst those who do not prosecute the crab fishing during these months. I have indicated however the descent of the curve during the months in question, because of the many general statements which have been made by fishermen as to the numbers of soft crabs at this period, the results arrived at by Williamson* from the statistics he gathered at Dunbar and indicated on the

*Williamson. Contributions to the Life-History of the Edible Crab. Report Scot. Fish. Board, 1900, p. 138.

diagram (W), and because of the figures I obtained at Beadnell† on November, 27th, 1902, and a determination made by Mr. Douglas in November, 1900, ('M' in Chart I.). Mr. Douglas wrote to me with reference to this latter counting:—"The catch of crabs for that day was 390, out of which 300 were put back to the sea as they were unfit for market." This is a proportion of 77 per cent. soft. The occurrence of the 5 points on the chart taken from Williamson's analysis of the Dunbar statistics suggests that the casting season is earlier at Dunbar than at Sea Houses, but as a matter of fact the seasons vary in this respect. The whole S-shaped curve may be said to move forwards or backwards in successive years according as the season is warm or cold. But at the same time it is more than probable that the general casting season differs slightly with the locality. The maximum proportion of soft crabs is said as a rule to be about 80 per cent., and Williamson actually found that to be the case at Dunbar in September, 1899. I have suggested in the diagram that it may be assumed to usually about touch that figure.

Berried crabs are not caught at all in accordance with the proportion they ought to bear to the un-berried females, and they are only caught from April to the end of the hatching season. During the six years there is only the record of three berried crabs being caught in March, 1 in 16 fathoms in 1902, and 2 in 26 fathoms in 1904; both at Sea Houses. The reason, so far as December and the early part of the year are concerned, is more than likely that they have just recently come into spawn, and there are few berried crabs at the end of the hatching season—September or at latest October. But above all we must remember that the great distension of the abdomen by the burden of eggs renders it very difficult for the female to enter the crab-pot.

It ought to be plain from this analysis that the important element in the catches of crabs is the high percentage of soft crabs obtained, especially from October to December, and that if further protection is necessary it is through the soft crab that it must be made.

Lobsters.—The soft lobster on the other hand is practically never seen in the crab pots, although at the end of the year the lobsters caught are sometimes not very 'heavy,' whereas the berried lobster bulks largely in the catches—up to 20 per cent. during the months when the lobster is usually caught. Not migrating with the crab, or at all events not nearly to the same extent, it enjoys more or less of a close time, for during certain months of the year, viz.:—

† Meek. Report Northd. Sea Fish. Com., 1902, p. 39.

at Beadnell, September to March, and Sea Houses, September to February or March, the pots if used at all are placed in situations unfavourable to the catching of lobsters. They may be caught however if pots are placed near to the rocks in the winter as is exemplified in this year's records for Sea Houses (Table 2).

It is thus apparent that if any improvement is to be made in the case of the lobster it must be through the berried female.

Mr. Douglas has kept a record for the six years of the number of small lobsters he has caught and returned to the sea. The small lobsters to the catch of 'hard' are as 478 : 4655 or 1 : 10. These are lobsters under the gauge size, and the numbers are interesting as showing to what extent the small lobsters may be caught in the pots, and also the number which have thus to be returned to the sea by the fishermen. In the North-Eastern District, the enquiry of 1895 elicited from two fishermen that the catch of small was as 1 : 5.

2.—CATCH PER 100 POTS.—It will be useful now to reduce the statistics from Sea Houses and Beadnell to the common level which naturally suggests itself—the catch per 100 pots per day. Tables V. and VI. give the results per 100 pots per month, and Tables VII. and VIII. the results per 100 pots per day. The averages for the six years so far as the hard crabs and lobsters are concerned are exhibited in graphic form in Chart III. The close set horizontal lines draw attention to the Beadnell, and the wider lines to the Sea Houses results. In both portions of the Chart the wide columns represent the Sea Houses, and the narrow columns the Beadnell figures.

Crabs.—In addition to the necessary re-statement in the tables of the above conclusions, it is now evident that the catches of crabs in the case of Beadnell gradually decrease from January to June, and each separate year tells the same story. At Sea Houses the diminishing of the catches does not occur to the same degree. A falling off certainly does take place, but the one year's records for the succeeding three months showed a slight improvement for July and August, and the season is not so early as that of Beadnell.

The general experiences of the fishermen may therefore be said to be that succeeding the casting season, that is, in January or February, large catches are made, that the catches gradually become less and less until the next casting season, when there is a heavy proportion of soft crabs, following which the relative completion of the hardening process brings about once more the large

numbers of the early part of the year. Towards the end of the summer, *vide* the Sea Houses figures, the diminution is to a large extent accounted for if the soft crabs be taken into consideration. It may therefore be concluded that the advent of casting affects the catches in the summer, and that the immense annual recuperation is also closely connected with this process. The large crowd of casters which appears in the autumn is rapidly reaching the hard condition from November to January, as has already been evident from the preceding section; they include the majority at least of the females which were berried in the early part of the year, and also the crabs which at this period of ecdysis pass into the plus-gauge size.

Lobsters.—With regard to lobsters the conditions are as opposite as they could be. In the first place, as has already been stated, the soft lobster does not come into the case at all. Secondly, as can be clearly seen in the upper portion of Chart III., there is a gradual rise in the numbers from about February or March to May, and this is succeeded by an equally gradual falling off in the catches until about August and September. At this latter period, the removal of the crab pots to deeper water by the fishermen who prosecute the winter fishing for crabs, practically excludes the catching of lobsters. In some cases, as has already been said, special pots are placed closer inshore to catch them alone, but the risk to the gear in such situations is very great, and frequently old pots of little value are used by those who attempt this winter fishing for lobsters. The catches are principally made by the regular crab and lobster fishermen in the spring and early summer, when the pots have been brought into the shore waters.

Thirdly, a great quantity of small, and a large percentage of berried lobsters enter the crab pots.

It is also to be noted that the captures of the fishermen measure the feeding activities of the species. The impulse of hunger is greatest during the hardening period, the pots at the end of the year contain large numbers of soft crabs, often as many as 20 or 30 in a pot, and it diminishes in intensity as the crabs become hard, and especially at the approach of the next ecdysis.

3.—PROPORTIONAL NUMBERS OF SEXES.—Tables IX. and X. set forth the numbers of the hard crabs and lobsters which enter the crab pots, arranged according to sex. In both cases it is evident that the females are in excess of the males.

The results grouped for Crabs (hard, soft, berried), and for Lobsters (hard, small, berried).

TABLE III. **CRABS**—SEA HOUSES.

	1899.			1900.			1901.			1902.			1903.			1904.			Totals.			Averages.		
	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.
January																330	85	—	330	85	—	330	85	—
February							325	2	—				2095	72	—	738	88	—	3158	162	—	1053	54	—
March ...				150	—	—	1598	17	—	581	7	1	2489	52	—	1439	69	2	6257	145	3	1251	29	1
April ...	1907	22	11	3239	5	6	2156	3	4	2739	11	4	5000	96	4	1287	58	1	16328	195	30	2721	32	5
May ...	1276	6	21	3818	15	16	4046	2	9	1836	4	7	2095	37	1	2604	43	7	15675	107	61	2613	18	10
June ...	1308	132	3	437	4	3	2714	2	12	1370	2	10	1034	9	4	131	6	2	6994	155	34	1166	26	6
July ...	525	138	—							2619	57	4							3144	195	4	1572	97	2
August...										2173	255	1							2173	255	1	2173	255	1
Sept. ...										219	153	—							219	153	—	219	153	—
	5016	298	35	7644	24	25	10839	26	25	11537	489	27	12713	266	9	6529	349	12	54278	1452	133	9046	242	22

LOBSTERS—SEA HOUSES.

	1899.		1900.		1901.		1902.		1903.		1904.		Totals.		Averages.	
	Hard.	Berried.	Hard.	Berried.	Hard.	Berried.	Hard.	Berried.	Hard.	Berried.	Hard.	Berried.	Hard.	Berried.	Hard.	Berried.
January											2	—	2	—	2	—
February					3	—			1	—	41	2	45	2	15	1
March ...			1	—	8	—	6	—	—	—	63	2	78	2	16	—
April ...	54	5	28	3	61	8	4	3	7	2	263	57	417	78	70	13
May ...	127	27	56	10	61	6	58	8	392	91	193	76	887	218	148	36
June ...	118	30	4	—	10	—	46	7	88	18	25	11	291	66	48	11
July ...	32	7					13	—					45	7	22	3
August...							2	3					2	3	2	3
Sept. ...							2	1					2	1	2	1
	331	69	89	13	143	14	131	22	488	111	587	148	1769	377	295	63

TABLE III. (CONTINUED). **CRABS**—BEADNELL.

	1899.			1900.			1901.	1902.	1903.	1904.	Totals.			Averages.		
	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Hard.	Hard.	Hard.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.
January							6180	7440	2260	3220	19100			4775		
February							4960	1540	5060	3620	15180			3795		
March ...							4360	1800	3910	4020	14090			3522		
April ...	4269	26	13	4498	22	4	2635	4776	3272	3204	22654	48	17	3776	24	8
May ...	1403	—	11	2636	—	20	2461	3209	1681	1775	14165		31	2361	—	15
June ...	1125	34	8	800	—	5	2145	1899	1128	1142	8239	34	13	1373	17	6
	6797	60	32	7934	22	29	23741	20664	17311	16981	93428	82	61	15571	41	30

LOBSTERS—BEADNELL.

	1899.			1900.			1901.			1902.			1903.			1904.			Totals.			Averages.		
	Hard.	Small.	Berried.	Hard.	Small.	Berried.	Hard.	Small.	Berried.	Hard.	Small.	Berried.	Hard.	Small.	Berried.	Hard.	Small.	Berried.	Hard.	Small.	Berried.	Hard.	Small.	Berried.
January							—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
February							—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
March ...							—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
April ...	236	24	22	298	24	14	151	36	10	198	15	12	130	3	9	129	5	9	1142	107	76	190	18	13
May ...	279	18	32	298	21	40	267	48	33	247	45	28	749	51	133	749	44	114	2589	227	380	431	38	63
June ...	140	17	56	119	16	32	170	30	44	70	18	16	228	32	54	197	31	54	924	144	256	154	24	43
	655	59	110	715	61	86	588	114	87	515	78	56	1107	86	196	1075	80	177	4655	478	712	776	80	119

TABLE IV. The results of Table III. arranged to show the percentage relationships.

1. **CRABS**—SEA HOUSES.

	1899.			1900.			1901.			1902.			1903.			1904.			Totals.		
	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.
January																80	20	—	80	20	—
February							99	1					96·7	3·3	—	90	10	—	95	5	—
March ...				100	—	—	99	1	—	98·8	1	·2	98	2	—	95	4·9	·1	97·7	2·3	·05
April ...	98·5	1	·5	99·6	·2	·2	99·7	·1	·2	99·5	·4	·1	98	1·9	·1	95·6	4·3	·1	98·7	1·1	·2
May ...	97·5	·5	2	99·2	·4	·4	99·75	·05	·2	99·6	·2	·4	98·7	1·25	·05	98·8	1·6	·2	98·9	·7	·4
June ...	90·8	9	·2	98	1	1	99·4	·1	·5	99·2	·1	·7	98·7	·9	·4	94·3	4·3	1·4	97·4	2·1	·5
July ...	79	21	—					·1		97·7	2·1	·2							93·9	6	·1
August...										89·46	10·5	·04							89·5	10·5	·04
Sept. ...										59	41	—							59	41	—
Averages	94	5	1	99	·5	·5	99·4	·2	·2	95·8	4	·2	97·9	2	·07	94·8	5·0	·2	97·2	2·6	·2

2. BEADNELL. **CRABS.**

	1899.			1900.		
	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.
January						
February						
March ...						
April ...	99·1	·6	·3	99·4	·5	·1
May.....	99·2	—	·8	99·2	—	·8
June ...	96·3	3	·7	99·4	—	·6
July.....						
August...						
Sept. ...						
	98·8	·9	·5	99·3	·3	·4

3. SEA HOUSES. **LOBSTERS.**

	Totals.		
	Hard.		Berried.
January	—	—	—
February	96	—	4
March ...	97·5	—	2·5
April ...	84	—	16
May.....	80	—	20
June ...	81		19
July.....	87		13
August...	—		—
Sept. ...	—		—
	82		18

4. BEADNELL. **LOBSTERS.**

	Totals.		
	Hard.		Berried.
	—		—
	—		—
	—		—
	94		6
	87		13
	78		22
	87		13

5. BEADNELL. **LOBSTERS.**

	Totals.		
	Hard.	Small.	Berried.
	—	—	—
	—	—	—
	—	—	—
	86·3	8	5·7
	81	7	12
	70	11	19
	80	8	12

TABLE V. SEA HOUSES.—Catch per 100 pots for each month each year.

CRABS.

	1899.				1900.				1901.				1902.				1903.				1904.				Average.			
	Days.	Hard.	Soft.	Berried.	Days.	Hard.	Soft.	Berried.	Days.	Hard.	Soft.	Berried.	Days.	Hard.	Soft.	Berried.	Days.	Hard.	Soft.	Berried.	Days.	Hard.	Soft.	Berried.	Days.	Hard.	Soft.	Berried.
January																					4	247	64	0	4	247	64	0
February									5	625	4	0					8	2686	92	0	7	738	88	0	7	1350	61	0
March ...					2	231	0	0	11	1804	19	0	8	710	8·5	1·2	11	2305	48	0	12	1274	61	2	9	1265	28	1
April ...	12	1465	17	8·5	19	3409	5	6·5	21	1487	2	3	21	2282	9	3	13	3145	60	2·5	20	919	41	1	18	2118	25	5
May.....	24	1175	5	19	25	3349	13	14	24	2932	1·5	6·5	16	1517	3	6	22	1248	22	1	24	1627	27	4	22·5	1975	12	8
June ...	26	1338	135	3	5	341	3	2	20	2423	2	11	15	1213	2	9	11	672	6	3	4	82	4	1	13·5	1012	25	5
July.....	7	610	160·5	0									22	2786	61	4									14	1698	111	2·1
August...													18	2173	255	1									18	2173	255	1
Sept.....													3	243	170	0									3	243	170	0

LOBSTERS.

January																					4	2	—	—	4	2	—	—
February									5	6	—	—					8	1	—	—	*7	41	—	2*	6	3	—	—
March ..					2	1	—	—	11	9	—	—	8	7	—	—	11	—	—	—	12	59	—	2	9	15	--	—
April ...	12	41	—	4	19	29	—	3	21	42	—	6	21	3	—	3	13	4	—	1	20	188	—	40	18	51	—	9
May.....	24	115	—	24	25	49	—	9	24	44	—	4	16	48	—	7	22	233	—	54	24	121	—	47	22	102	--	24
June ...	26	120	—	31	5	3	—	—	20	9	—	—	15	41	—	6	11	57	—	12	4	16	—	7	13	41	—	9
July.....	7	36	—	8									22	14	—	—									14	25	—	—
August													18	2	—	3									18	2	—	3
Sept.....													3	2	—	1									3	2	—	1

* 6 faths. 17 pots

TABLE VI. BEADNELL.—Catch per 100 pots for each month each year.

CRABS.

	1899.				1900.				1901.		1902.		1903.		1904.		Average.			
	Days.	Hard.	Soft.	Berried.	Days.	Hard.	Soft.	Berried.	Days.	Har .	Days.	Hard.	Days.	Hard.	Days.	Hard.	Days.	Hard.	Soft.	Berried.
January									15	6180	19	7440	11	2260	11	3220	14	4775		
February									15	4960	10	1540	14	5060	12	3620	13	3795		
March ...									16	4360	16	1200	21	2607	19	2680	18	2712		
April ...	21	1840	11	5·5	22	1828	9	1·5	22	1062	24	1910	17	1309	17	1282	20·5	1539	·6	·2
May ...	25	605	0	5	25	1071	0	8	26	1396	20	1284	25	672	25	710	24	956	—	·3
June ...	25	570	18	4	23	400	0	2·5	21	864	18	760	19	451	19	457	21	584	·4	·1

LOBSTERS.

	1899.				1900.				1901.				1902.				1903.				1904.				Average.			
	Days.	Hard.	Small.	Berried.	Days.	Hard.	Small.	Berried.	Days.	Hard.	Small.	Berried.	Days.	Hard.	Small.	Berried.	Days.	Hard.	Small.	Berried.	Days.	Hard.	Small.	Berried.	Days.	Hard.	Small.	Berried.
January	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
February	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
March ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
April ...	21	103	10	10	22	121	10	6	22	63	15	4	24	79	6	5	17	52	4	4	17	52	4	2	20·5	78	8	5
May ...	25	121	8	14	25	121	8·5	16	26	111	20	14	20	99	18	11	25	300	20	53	25	300	46	18	24	175	20	21
June ...	25	74	9	29·5	23	59·5	8	16	21	71	12·5	18	18	28	7	6	19	91	13	22	19	79	22	12	21	67	12	17

TABLE VII. SEA HOUSES.—Catch per 100 pots per day for each month each year.

CRABS.

	1899.			1900.			1901.			1902.			1903.			1904.			Averages.		
	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.
January																62	16	—	62	16	—
February							125	·8	—				336	11	—	105	12	—	202	9·2	—
March ...				115	—	—	164	2	—	89	1	·1	210	4	—	106	5	·2	144	3	·1
April ...	122	1·4	·7	179	·3	·3	71	·1	·1	109	·5	·1	242	4	·2	46	20	·1	120	1·3	·2
May ...	49	·2	·8	134	·5	·6	122	·6	·3	95	·2	·4	57	1	·1	68	1	·2	88	·5	·4
June ..	51	5	·1	68	·6	·4	121	·1	·5	81	·1	·6	61	·5	·3	20	1	·1	75	1·9	·4
July ...	87	23	—							127	3	·2							117	7·6	·2
August...										121	14	·1							121	14	·1
Sept. ...										81	57	—							81	57	—

LOBSTERS.

	1899.		1900.		1901.		1902.		1903.		1904.		Averages.	
	Hard.	Berried.	Hard.	Berried.	Hard.	Berried.	Hard.	Berried.	Hard.	Berried.	Hard.	Berried.	Hard.	Berried.
January											·5	—	·5	—
February					1	—			·1		—	—	·5	—
March ...			·5	—	·8	—	1	—	—	—	5	—	2	—
April ...	3	·3	2	·2	2	·3	·2	·1	·3	·1	9	2	3	·6
May.....	5	1	2	·4	2	·2	3	·4	11	2	5	2	5	1
June ...	4	1·2	·6	—	·5	—	3	·4	5	1	4	2	3	·7
July.....	5	1					6	—					2	—
August...							·1	·2					·1	·2
Sept.....							·7	·3					·7	·3

TABLE VIII. BEADNELL.—Catch per 100 pots per day for each month each year.

CRABS.

	1899.			1900.			1901.	1902.	1903.	1904.	Averages.		
	Hard.	Soft.	Berried.	Hard.	Soft.	Berried.	Hard.	Hard.	Hard.	Hard.	Hard.	Soft.	Berried.
January							412	392	205	293	341		
February							331	154	361	302	298		
March ...							272	75	124	141	151		
April ...	88	·5	·3	83	·4	·1	48	80	77	75	75	4	·2
May ...	24	—	·2	43	—	·3	54	64	27	28	39	—	·2
June ...	23	·7	·2	17	—	·1	41	42	24	24	28	·3	·1

LOBSTERS.

	1899.			1900.			1901.			1902.			1903.			1904.			Averages.		
	Hard.	Small.	Berried.	Hard.	Small.	Berried.	Hard.	Small.	Berried.	Hard.	Small.	Berried.	Hard.	Small.	Berried.	Hard.	Small.	Berried.	Hard.	Small.	Berried.
April ...	5	·5	·5	5·5	·5	·3	3	·7	·2	3·3	·2	·2	3	·2	·2	3	·2	·1	4	·4	·2
May ...	5	·3	·6	5	·3	·6	4·3	·8	·5	·5	·9	·5	12	·8	2	12	2	·7	7	·8	·9
June ...	3	·4	1·2	2·6	·3	·7	3·4	·6	·9	1·5	·4	·3	5	·7	1·1	4·2	1·1	·6	3	·6	·8

TABLE IX.—**SEXES OF CRABS.**

1. SEA HOUSES.

	1899.				1900.				1901.				1902.				1903.				1904.				Totals.			
	Males.	Females	Berried Females	Total Females	Males	Females	Berried Females	Total Females	Males	Females	Berried Females	Total Females	Males	Females	Berried Females	Total Females	Males	Females	Berried Females	Total Females	Males	Females	Berried Females	Total Females	Males	Females	Berried Females	Total Females
January									150	175	—	175									154	176	—	176	154	176	—	176
February																	1049	1046	—	1046	262	476	—	476	1461	1697	—	1697
March ...					85	65	—	65	827	771	—	771	320	261	1	262	1506	983	—	983	411	1028	2	1030	3149	3108	3	3111
April ...	745	1195	11	1206	1624	1615	6	1621	1140	1016	4	1020	1412	1327	4	1331	2282	2718	4	2722	321	966	1	967	7524	8837	30	8867
May.....	698	606	21	627	1861	1957	16	1973	1784	2262	9	2271	973	863	7	870	1040	1055	1	1056	1242	1362	7	1369	7598	8105	61	8166
June ...	786	525	3	528	205	232	3	235	1315	1399	12	1411	689	681	10	691	554	480	4	484	61	70	2	72	3610	3387	34	3421
July.....	336	189	—	189									1520	1099	4	1103									1856	1288	4	1292
August...													545	1628	1	1629									545	1628	1	1629
Sept.....													63	156	—	156									63	156	--	156
	2565	2515	35	2550	3775	3869	25	3894	5216	5623	25	5648	5522	6015	27	6042	6431	6282	9	6291	2451	4078	12	4090	25960	28382	133	28515

2. BEADNELL.

	1899.				1904.				Totals.			
	Males	Females	Berried Females	Total Females	Males	Females	Berried Females	Total Females	Males	Females	Berried Females	Total Females
January					1830	1390	—	1390	1830	1390	—	1390
February												
March ...												
April ...	2066	2203	13	2203					2066	2190	13	2203
May.....	663	740	11	740					663	729	11	740
June ...	567	558	8	558					567	550	8	558
	3296	3501	32	3501					5126	4859	32	4891

TABLE X.—**SEXES OF LOBSTERS.**

SEA HOUSES.

	1899.				1900.				1901.				1902.				1903.				1904.				Totals.			
	Males	Females	Berried Females	Total Females	Males	Females	Berried Females	Total Females	Males	Females	Berried Females	Total Females	Males	Females	Berried Females	Total Females	Males	Females	Berried Females	Total Females	Males	Females	Berried Females	Total Females	Males	Females	Berried Females	Total Females
January																					2	—	—	—	2	—	—	—
February									2	1	—	1					1	—	—	—	21	20	2	22	24	21	2	23
March ...					1	—	—	—	6	2	—	2	5	1	—	1	—	—	—	—	31	32	2	34	43	35	2	37
April ...	36	18	5	23	17	11	3	14	36	25	8	33	3	1	3	4	4	3	2	5	116	147	57	204	212	205	78	283
May.....	82	45	27	72	35	21	10	31	34	27	6	33	30	28	8	36	182	210	91	301	99	94	76	170	462	425	218	643
June ...	69	49	30	79	2	2	—	2	5	5	—	5	24	22	7	29	42	46	18	64	10	15	11	26	152	139	66	205
July.....	15	17	7	24									7	6	—	6									22	23	7	30
August...													2	—	3	3									2	—	3	3
Sept.....													2	—	1	1									2	—	1	1
	202	129	69	198	55	34	13	47	83	60	14	74	73	58	22	80	229	259	111	370	279	308	148	456	921	848	377	1225

The totals for the years and the months in Table IX. are expressed in percentages in Tables XI. and XII, and from the latter, Chart IV. has been prepared. In this chart, as in the preceding ones, the wider columns represent the proportions at Sea Houses and the narrower columns those at Beadnell. The males are distinguished by the small vertical lines, the berried females by the small portions of the columns at the right hand enclosing small horizontal lines, and the females not berried by the intervening white parts of the columns.

TABLE XI.—Yearly Proportional Numbers of the Sexes of Crabs.

Sea Houses.	Males.	Females.	Berried Females.	Total Females.
1899	50	49	1	50
1900	49	50·7	·3	51
1901	48	51·8	·2	52
1902	48	51·7	·3	52
1903	50	49·9	·1	50
1904	37·5	62·3	·2	62·5
All the years.	47·7	52·1	·2	52·3
Beadnell.				
1899	48·5	51	·5	51·5

TABLE XII.—Monthly Proportional Numbers of the Sexes of Crabs.

Sea Houses.	Males.	Females.	Berried Females.	Total Females.
January ...	47	53		53
February ...	46	54		54
March ...	50·3	49·65	·05	48·85
April ...	45·9	53·9	·2	54·1
May ...	48·2	51·4	·4	51·8
June ...	51·3	48·2	·5	48·7
July ...	59	40·9	·1	41
August ...	25	75	·05	75·05
September ...	29	71		71
Beadnell.				
January ...	57	43		43
April ...	48·4	51·3	·3	51·6
May ...	47·2	52	·8	52·8
June ...	50·4	48·9	·7	49·7

The large number of females would be still further increased if records had been furnished for the last three months of the year. During that period, as Wilson* stated, a very large proportion of the marketable crabs are females; females, it may be added, which for

* Rep. Northd. Sea Fish. Com., 1893.

the most part are about to come into berry. Not only so, but it has also to be recalled that the berried females are very infrequently caught in the earlier part of the year.

The small number of male crabs caught in the autumn and latter part of the year is associated with the breeding habits of the species and the subsequent casting of the males. But the latter become more and more numerous and according to Mr. Douglas become predominant to a slight degree in the beginning of the year.* The figures set forth above do not bear this out, but an inspection of Table IX. shows that usually a period arrives in the early part of the year when the males are slightly in excess. This slight excess on the part of the males is not sufficient, however, when we bear in mind the fact that so few berried females are accounted for, to prove that the sexes are about equal in numbers. It is very probable for this reason that the proportions given at the bottom of Table XI. are to some extent rather above than below the percentage of males in nature. The facts and the conclusions are on the whole in agreement with those arrived at by Cunningham† and by Williamson.‡

Lobsters.—The totals in Table X. are expressed in percentages in Tables XIII. and XIV. and the figures of the latter Table are incorporated in Chart II.

TABLE XIII.—Yearly Proportional Numbers of the Sexes of Lobsters.

Sea Houses.	Males.	Females.	Berried Females.	Total Females.
1899	50	32	17	50
1900	54	33	13	46
1901	53	38	9	47
1902	48	38	14	52
1903	38	43	19	62
1904	38	42	20	62
All the years.	43	39	18	57

Beadnell.	Males and Females.	Berried Females.
1899	86	14
1900	89	11
1901	87	13
1902	90	10
1903	85	15
1904	86	14
All the years.	87	13

* Meek. Rep. Northd. Sea Fish. Com., 1898, p. 29.
† Cunningham. Rep. Cornwall Tech. Ed. Com., 1898, p. 3.
‡ Williamson. Op. cit., p. 100.

TABLE XIV.—Monthly Proportional Numbers of the Sexes.

Sea Houses.	Males.	Females.	Berried Females.	Total Females.
February ...	51	45	4	49
March ...	53·5	44	2·5	46·5
April ...	43	41	16	57
May ...	41·5	38·5	20	58·5
June ...	42	39	19	58
July ...	43	44	13	57

It would appear from these figures that the male lobsters tend to be more numerous in the early part of the year, and that thereafter the females are in excess. I have no statistical knowledge of the proportion of the sexes in the latter part of the year, and very little for the latter part of the summer, but, so far as I have been able to gather, there is no distinct disproportion between the sexes towards the end of the year, and there is a practical absence of berried hens. The totals may then be taken to represent with considerable accuracy the proportional numbers of the sexes caught during the year. The berried females are not caught to such an extent as unberried females, and the figures are therefore only liable to error in the earlier months and the later months of the year, from the fact which the figures themselves disclose, that the berried lobster does not leave the neighbourhood of the rocks to the same degree as the males and the unberried females. The numbers for April, May, and June are for these reasons to be preferred. They are, males, 827; females, 769; berried females, 362; total females, 1131; giving a proportion of males, 42; females, 39; berried females, 19. At Beadnell on the other hand the berried females only amounted to 13 per cent. in the six years. It is a point both with reference to crabs and lobsters which well deserves restatement.

Berried Crabs and Berried Lobsters.—During the six years at Sea Houses there were caught 133 berried to 54,178 hard or marketable crabs, or 1 to 407. At Beadnell for 1899 and 1900 there were caught 61 berried to 14,731 hard crabs, or 1 to 241. The proportion of the berried to the unberried female crabs was in the case of Sea Houses 1 to 213, and for 1899 at Beadnell 1 to 109. In the same manner the proportion of berried to hard lobsters is as follows:—

	Sea Houses.	Beadnell.
February ...	1 to 22 ...	
March	1 to 39 ...	
April	1 to 5 ...	1 to 15
May	1 to 4 ...	1 to 7
June	1 to 4 ...	1 to 4
July	1 to 6 ...	
Totals	1 to 5 ...	1 to 6·5
April to June ...	1 to 4 ...	

The proportion of the berried to the unberried female lobsters (Sea Houses) is 1 to 2·25.

This indicates still more clearly the immense dissimilarity between the crab and the lobster with regard to the number of the berried females liable to be caught by the fishermen.

It must be admitted in consequence that no better choice of months could have been made than that adopted by the Northumberland Committee in their local bye-law framed to protect the berried lobster, and that if improvement has resulted and further improvement is to be sought in legislation, it would be no great hardship to protect the berried lobster altogether.

4.—STATISTICAL ACCOUNT.

1.—Sea Houses and Beadnell.—The total catches of crabs and lobsters at Sea Houses and Beadnell for the years we have been considering as given in the Government returns are set forth in Tables XV. and XVI. The average annual catch at Sea Houses for crabs is 193,988, valued at £1,545, and at Beadnell, 250,837, value £2,145; for lobsters at Sea Houses the annual average catch is 2,930, value £127; for Beadnell, 2,178, value £111. The average values of these fisheries for the six years are then, Sea Houses, £1,672; Beadnell, £2,256.

The average catches are introduced in the lower part of Charts V. and VI. From these and the tables, it is evident that there is a general agreement between the two places as to the maximum results being obtained about April or May. At Beadnell, however, the catches of crabs are much greater in the early part of the year, and again the last months of the year are made to yield far more crabs at Beadnell than at Sea Houses. If it may be taken from the considerations of the preceeding sections that the proportion of soft crabs during these months is 65 per cent., it is evident that a large number of soft have to be caught in obtaining the annual supplies at Beadnell. To catch the 50,000 odd crabs at this period each year, some 72,000 soft or unmarketable have to be caught in addition and returned to the water; and, as has often been stated before, in a condition which renders the chances of recovery of many very problematic.

But whether this is a matter of moment or not would depend on any evidences of the fishery suffering. In that connexion it has to be noted that after the maximum in the early part of the year, there is a rapid falling off in the catches, and the figures for the successive years do not show any signs of improvement—the reverse at Beadnell. As has already been said, there is little doubt that

TABLE XV.—Catches of Crabs and Lobsters at Sea Houses.

CRABS.

	1899. Number.	1900. Number.	1901. Number.	1902. Number.	1903. Number.	1904. Number.	Totals.	Averages.
January	17520	140	6200	5340	2820	9515	41535	6922
February	29520	2640	19520	8460	39300	19432	118872	19812
March	32920	17540	21090	20740	45030	38810	176130	29355
April	40880	49840	16120	35120	68250	35796	246006	41001
May	29360	64860	47420	44160	37140	56682	279622	46604
June	13120	23580	25840	11270	27090	13358	114258	19043
July	16160	9520	6080	23020	7050	5767	64597	10766
August...	16320	2180	7780	15080	6990	7005	55355	9226
September	4320	2880	6500	3800	3780	6276	27556	4593
October	6140	—	2780	—	1150	13063	23133	3855
November	8160	—	—	—	—	5707	13867	2311
December	1200	—	—	—	—	1800	3000	500
	215620	173180	159330	166990	238600	213211	1163931	193988

LOBSTERS.

January	23	—	18	20	—	92	153	25
February	89	40	232	40	36	149	586	98
March	230	186	195	313	183	525	1632	272
April	578	747	488	506	507	1525	4351	725
May	745	1066	911	551	1365	1391	6029	1005
June	379	881	403	292	427	613	2995	499
July	294	163	81	114	46	164	862	144
August...	136	89	49	53	37	66	430	72
September	80	40	51	20	19	41	251	42
October	41	—	20	---	15	108	184	31
November	40	—	—	—	—	65	105	17
December	—	—	—	—	—	—	—	
	2635	3212	2448	1909	2635	4739	17578	2930

TABLE XVI.—Catches of Crabs and Lobsters at Beadnell.

CRABS.

	1899. Number.	1900. Number.	1901. Number.	1902. Number.	1903. Number.	1904. Number.	Totals.	Averages.
January	24140	36000	45700	38000	12200	20550	176590	29432
February	52800	28400	51100	8600	44000	21400	206300	34383
March	48500	37200	30370	13600	33800	40700	204170	34028
April	70000	60500	36600	40700	55100	23500	286400	47733
May	25600	36600	32900	51900	22600	44300	213900	35650
June	7200	8000	8400	13600	7200	9700	54100	9017
July	5200	1300	1800	3200	1950	1970	15420	2570
August	5100	1800	1700	1600	1900	2202	14302	2387
September	5100	4500	3350	6700	5100	6330	31080	5180
October	26700	13000	13900	16600	17200	17260	104660	17443
November	31200	17000	16200	9200	16600	18800	109000	18167
December	15000	23300	17200	4300	12600	16700	89100	14850
	316540	267600	259220	208000	230250	223412	1505022	250837

LOBSTERS.

January	—	—	—	—	—	—	—	—
February	—	—	—	—	—	—	—	—
March	140	159	100	60	253	400	1112	185
April	450	506	500	400	500	899	3255	542
May	802	1080	335	250	3084	1000	6551	1092
June	440	231	225	100	150	239	1385	231
July	109	50	40	60	—	—	259	43
August	—	—	—	—	—	—	—	—
September	—	—	—	—	—	—	—	—
October	—	—	—	—	—	160	160	27
November	—	—	—	—	—	168	168	28
December	—	—	—	—	—	176	176	29
	1941	2026	1200	870	3987	3042	13066	2178

the diminishing of the catches is a natural and unavoidable circumstance, but it is also quite conceivable that overfishing would intensify it.

With the information at our disposal, it is possible to arrive at an estimate of the crab pots in use. For instance, at Beadnell in April, the catch for the month is about 50,000 crabs, and if the catch per 100 pots per day at that period be said to be 100 crabs, and the number of days be 25, that would give 2,000 pots, which is actually just about the number.

In the case of lobsters, the figures and the chart show that in spite of the increase in the number of pots, the catches remain practically the same as in the results per 100 pots per day. This is certainly not the case with regard to crabs, and it leads to the reflexion that the fishermen are stating the truth when they say that at all events the catches of lobsters have considerably diminished since the modern intensification of the industry took place.

2.—Northumberland. — The Government statistics for the district of Northumberland are shown in Table XVII., and the averages for the six years are exhibited in graphic form in Charts V. and VI. The charts also include the figures for Sea Houses and Beadnell already referred to. It will be seen that the results are presented for the two divisions of the County adopted in the regulation of the district by the Committee. In Chart V. the numbers of the crabs along the left side refer to thousands, thus 20,000, 30,000 and so on. The catches for the Northern District are shown in both charts by a continuous, and for the Southern Division by an interrupted line.

The average values, according to the Government returns, are :—

	Crabs.	
Northern District	... ...	£8,876
Southern ,,	... ...	£2,700
Total	... ...	£11,576
	Lobsters.	
Northern District	... ...	£966
Southern ,,	... ...	£653
Total	... ...	£1,619

Thus the value of the Crab and Lobster Fisheries, as estimated at the ports of landing, is about £13,200.

TABLE XVII.—Catches of Crabs and Lobsters in Northumberland District.

CRABS.

	1899.		1900.		1901.		1902.		1903.		1904.		Totals and Averages.			
	Northern District.	Southern District.	Northern District.	Southern District.	Northern District.	Southern District.	Northern District.	Southern District.	Northern District.	Southern District.	Northern District.	Southern District.	Northern District.		Southern District.	
	Number.	Number.	Number.	Number.	Number.	Number.	Number.	Number.	Number.	Number.	Number.	Number.	Totals.	Averages.	Totals.	Averages.
January	97872	1824	84770	—	132220	2100	136940	6580	68080	940	82015	—	601897	100316	11444	1907
February	150655	4420	126551	420	221340	24790	70230	6040	219960	31700	111177	12945	899913	149985	80315	13386
March ...	190896	42120	146190	29590	181880	80390	82360	20246	171330	82805	171210	67790	943866	157322	322941	53823
April ...	285070	90610	299044	113590	162170	101070	275570	208810	331750	155620	139976	110220	1493580	248930	779920	129987
May.....	135370	85660	254660	125894	197775	92927	247170	140210	146590	96324	206147	89005	1187712	197952	630020	105003
June ...	63420	12290	55560	16141	67710	11600	95226	53060	58235	15737	47948	17212	388099	64683	126040	21007
July.....	32480	7540	25700	6506	25840	5029	58930	7371	21961	4980	17807	3680	182718	30453	35106	5851
August...	33740	12240	17283	5230	28760	4506	43270	2610	20430	3170	18407	3030	161890	26982	30786	5132
Sept.....	12060	5790	11416	6760	19020	200	21050	770	17193	3565	20216	3040	100955	16826	20125	3354
October	52120	4670	33370	2990	46280	15000	43200	860	56020	8460	57113	5180	288103	48017	37160	6193
Nov.....	63840	6040	43569	2340	38247	3560	24680	6100	60440	8530	58427	6470	289203	48200	33040	5507
Dec.....	37270	1580	44301	1100	44440	2600	26840	4920	39870	2530	42980	2750	235701	39283	15480	2580
	1154793	274784	1142414	310561	1165682	343772	1125466	457577	1211859	414361	973423	321322	6773637	1128939	2122377	353729

LOBSTERS.

January	36	90	—	—	70	250	41	—	69	67	678	450	894	149	857	143
February	283	135	132	—	664	120	120	—	501	202	755	217	2455	409	674	112
March ...	1305	802	1074	324	1905	229	2209	376	2601	1214	3400	1038	12494	2082	3983	664
April ...	3717	1716	5363	2697	4811	3100	3767	2523	5279	2007	7913	6691	30850	5142	18734	3122
May.....	5820	4612	5879	4749	5595	4414	2850	4943	12708	9364	7916	7333	40768	6795	35415	5902
June ...	2680	1906	2760	792	1576	292	1790	1545	2442	1167	3130	1881	14378	2396	7583	1294
July.....	753	890	473	452	387	185	845	417	297	463	572	312	3327	554	2719	453
August...	647	235	346	100	857	127	578	20	338	89	386	249	3152	525	820	137
Sept.....	1003	677	136	1227	334	245	528	120	840	1396	1179	1291	4020	670	4956	826
October	861	1951	237	1236	327	2107	154	2749	782	2301	2111	2519	4472	745	12863	2144
Nov.....	241	1104	407	663	448	923	169	1133	539	2636	818	1391	2622	437	7850	1308
Dec.....	38	214	170	590	—	38	—	96	377	806	486	861	1071	178	2605	434
	17384	14332	16977	12830	16974	12030	13051	13922	26773	21712	29344	24233	120503	20084	99059	16510

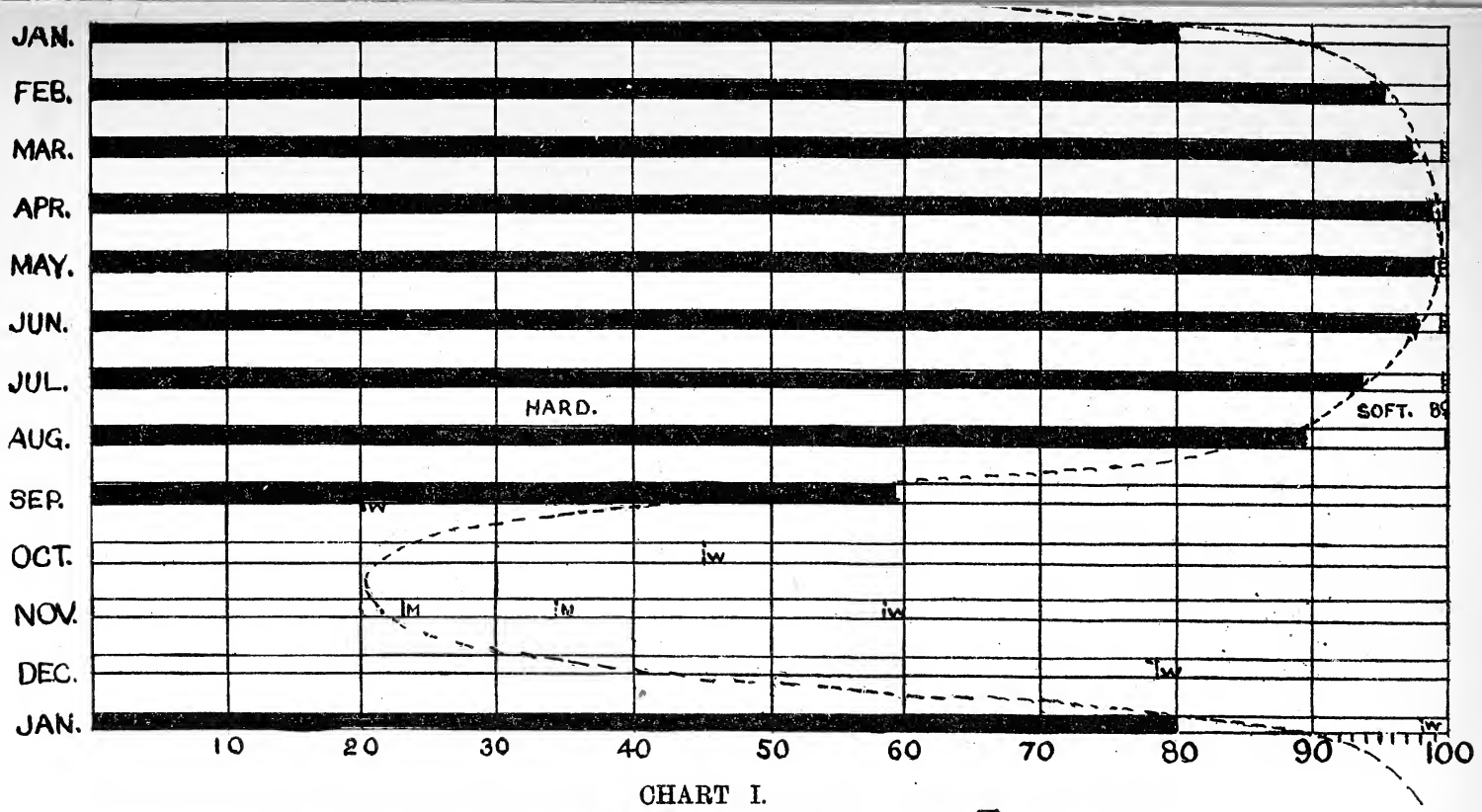


CHART I.

The proportional numbers of hard ▬, soft ▭, and berried ▤ crabs caught at Sea Houses.

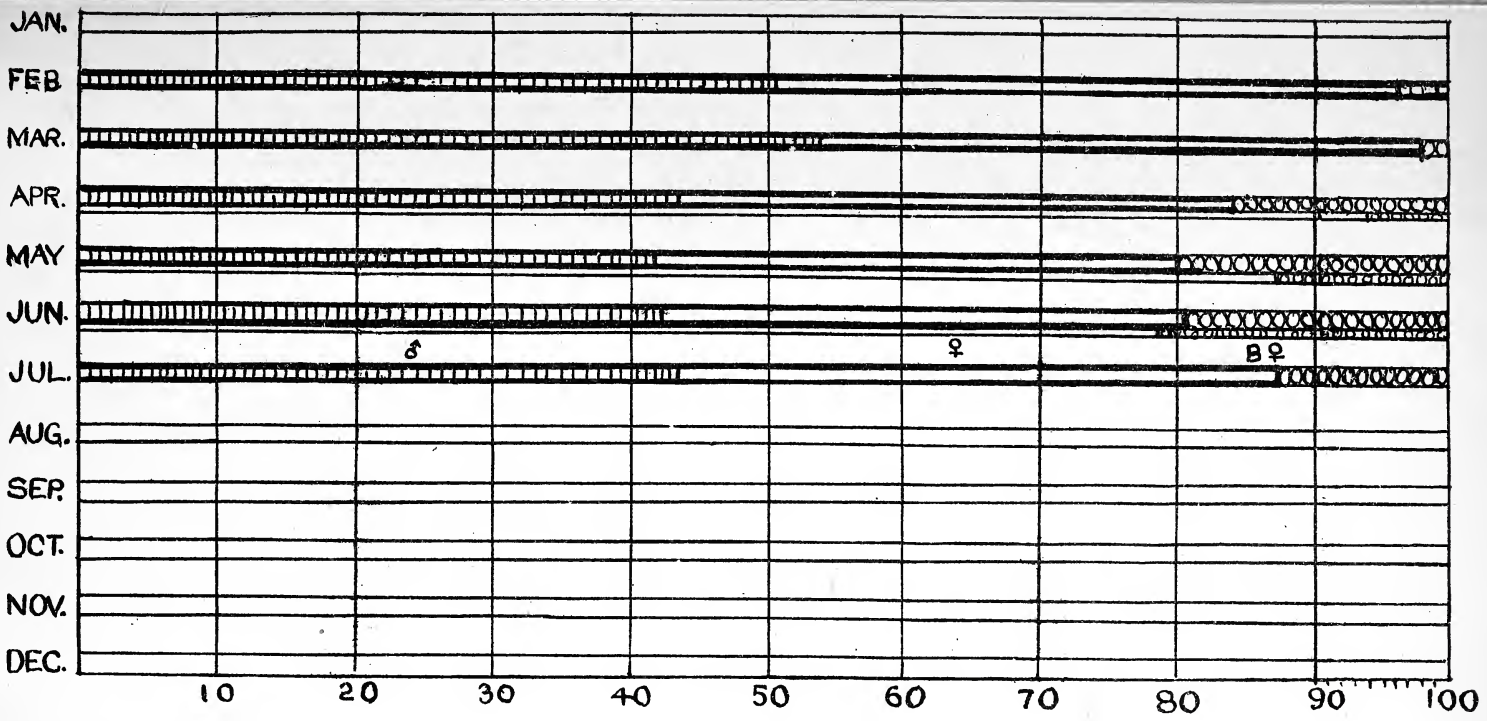


CHART II.

The proportional numbers of hard ▭ and berried ▭ lobsters caught at Sea Houses and Beadnell. The hard are sub-divided into males ▭ (on the left) and females ▭ (on the right).

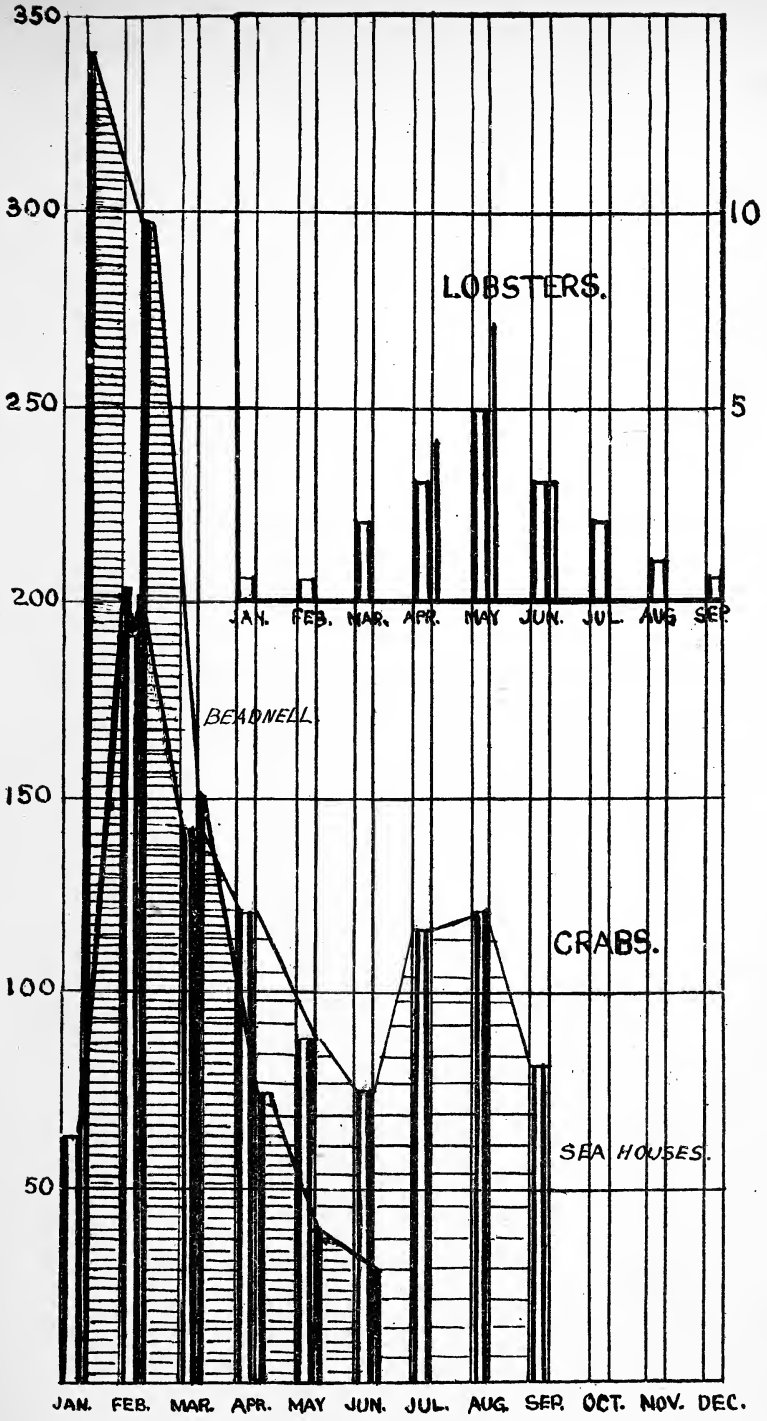


CHART III.

The average catches of crabs and of lobsters per 100 pots per day.

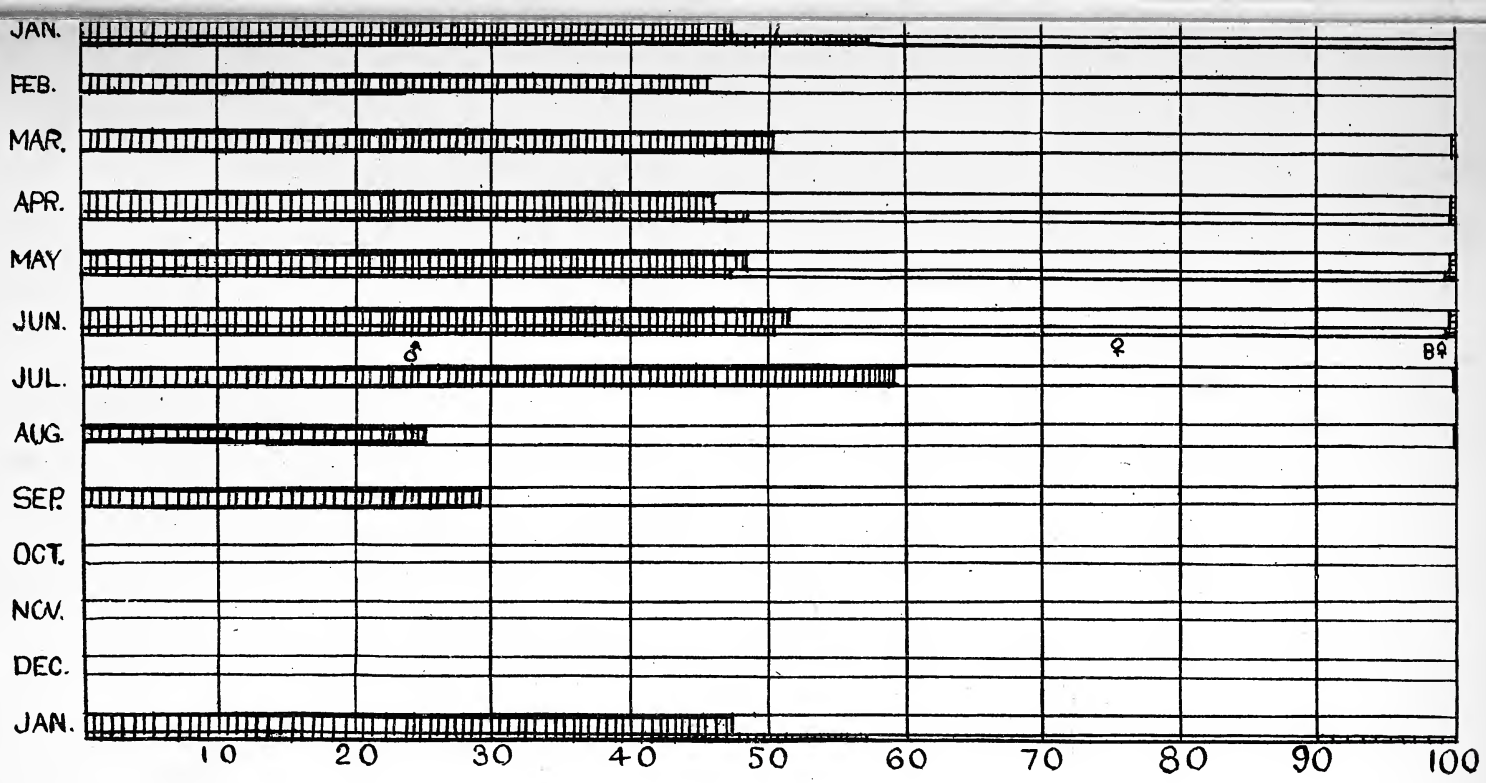


CHART IV.

The proportional numbers of the sexes of crabs. The males are shown on the left ▭, the females on the right ▭, and the berried females on the extreme right ▭

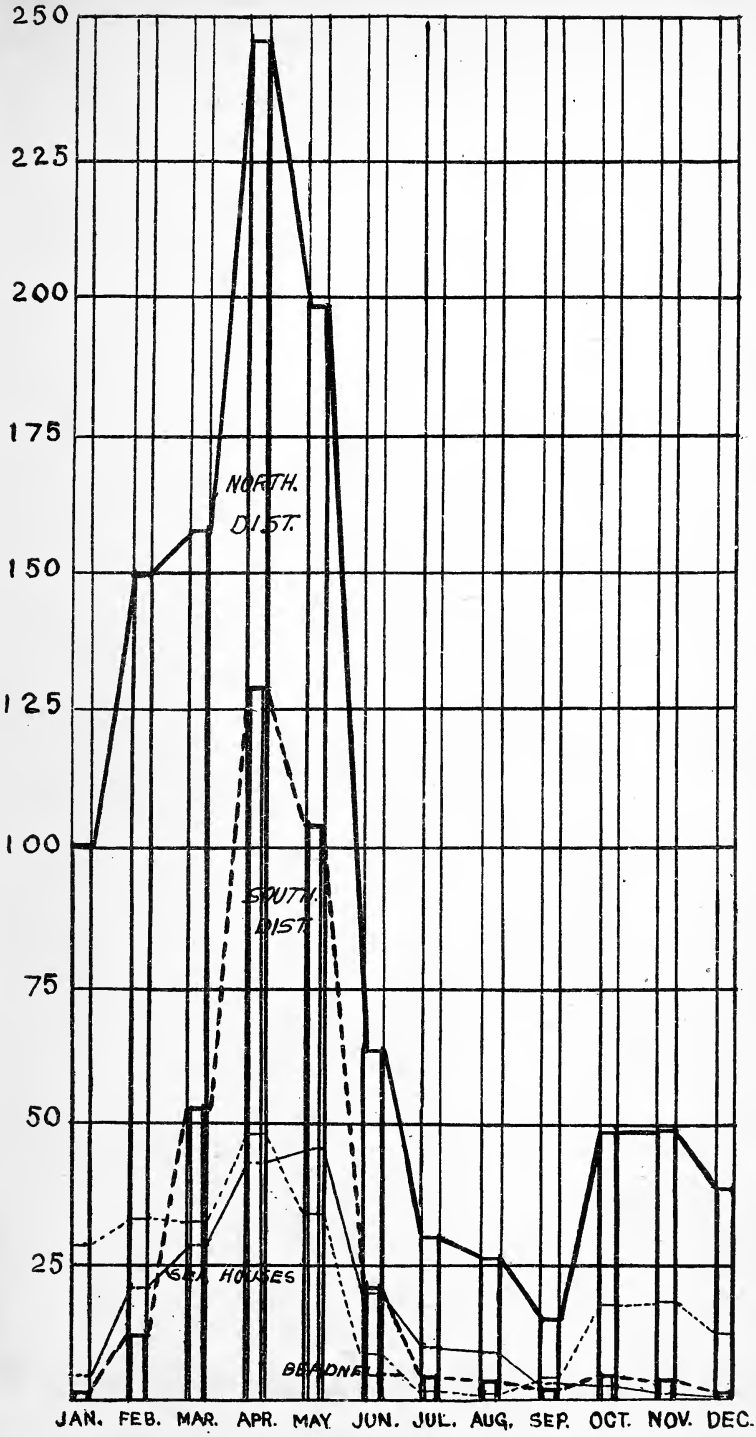


CHART V.

The average catches of crabs (in thousands) for each month for the years 1899-1904, to show the catches in the Northern District, the Southern District, and at Sea Houses and Beadnell.

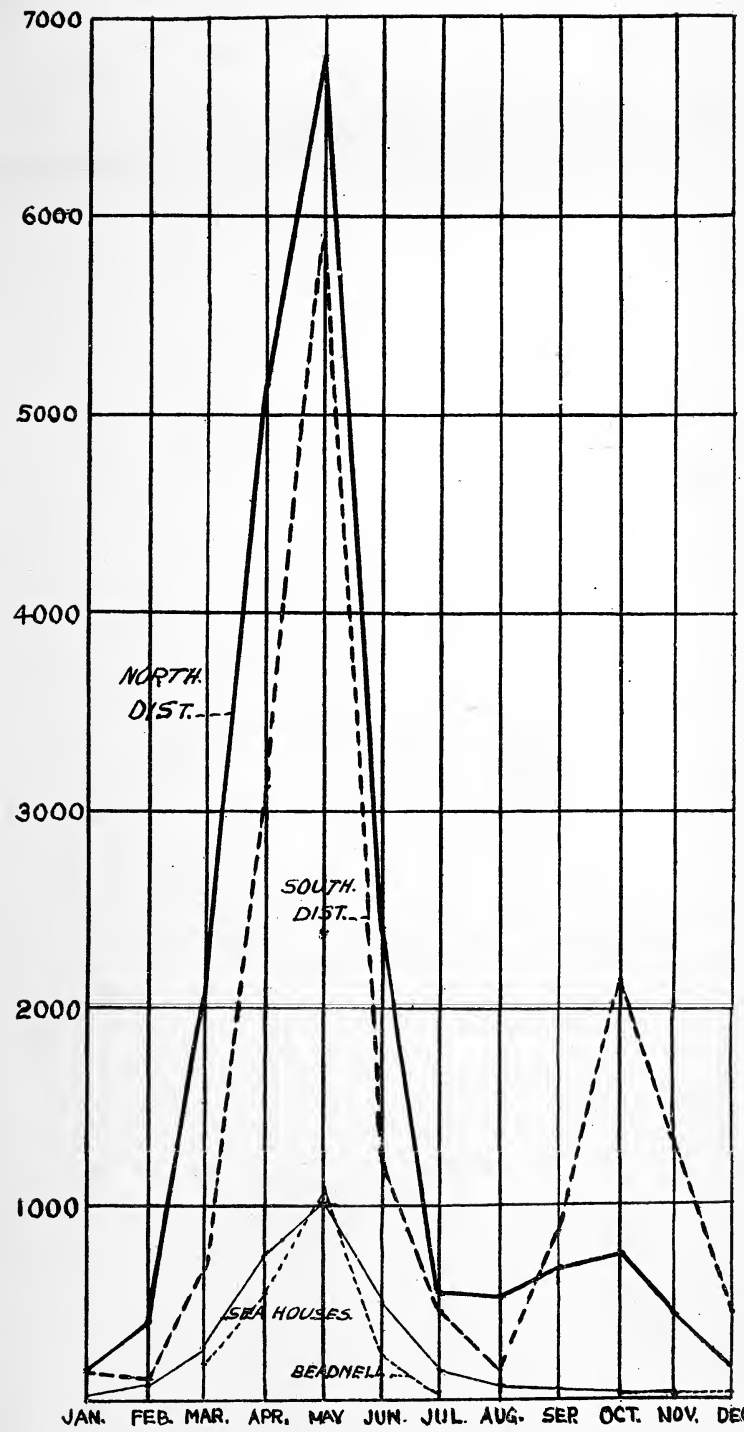


CHART VI.

The average catches of lobsters for each month for the years 1899-1904, to show the catches in the Northern District, the Southern District, and at Sea Houses and Beadnell.

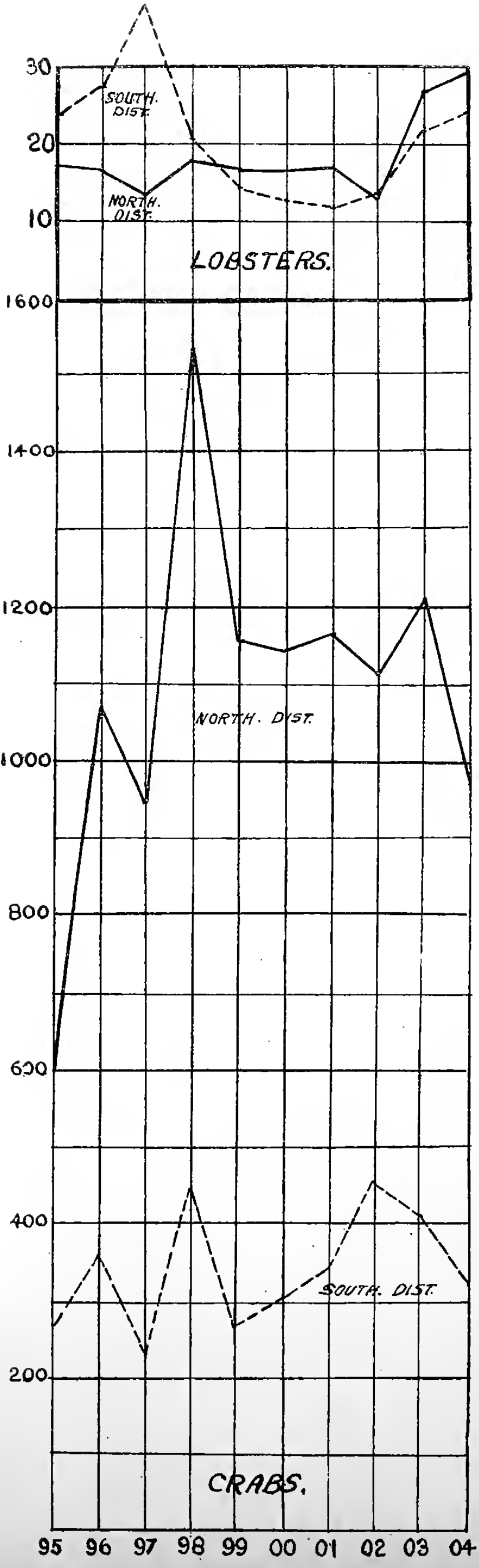


CHART VII.

The numbers of crabs and of lobsters (in thousands) caught each year from 1895 to 1904, in the Northern and in the Southern districts.

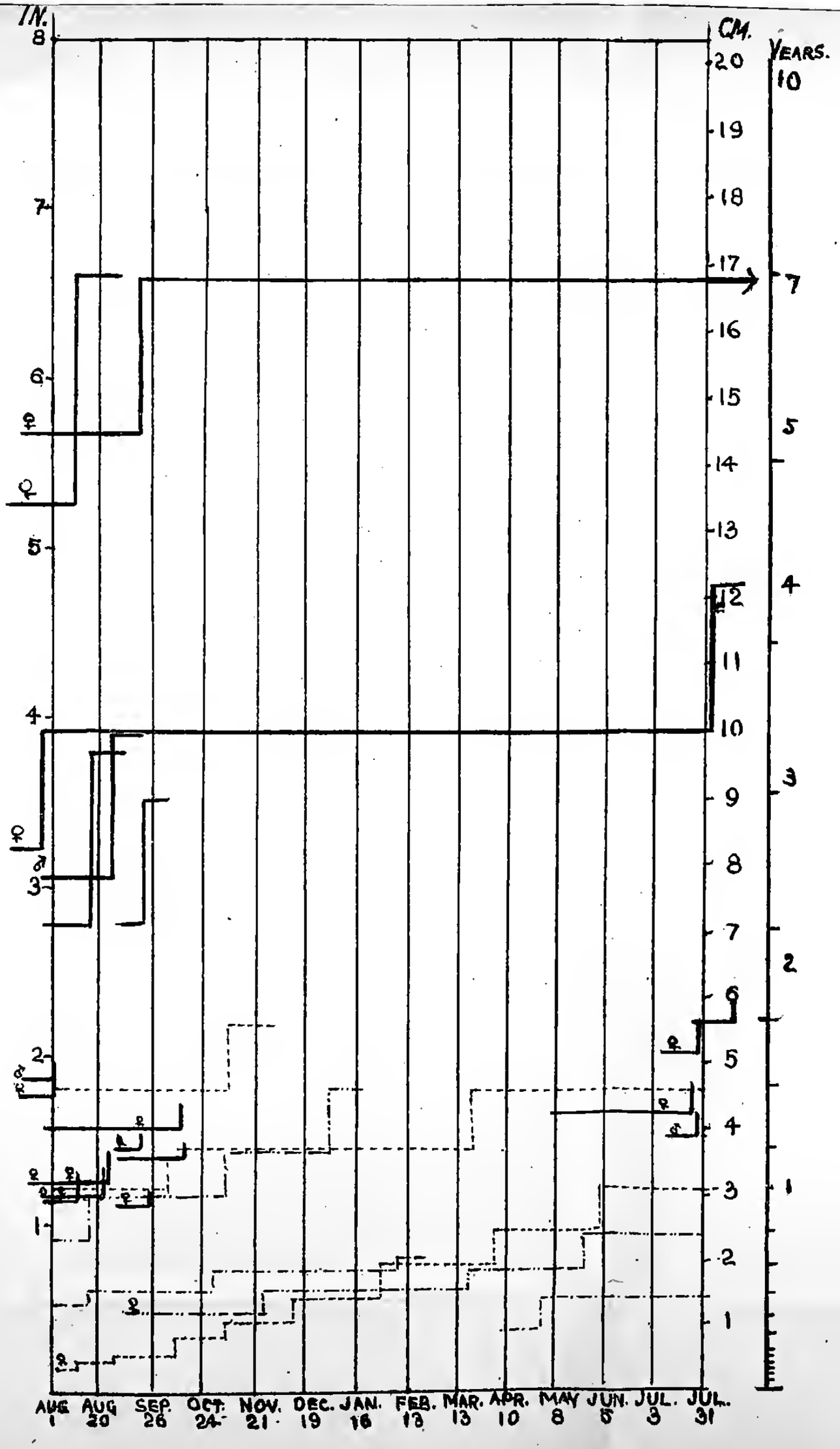


CHART VIII.

The growth of the crab. The thick lines show the ecdyses which occurred at Cullercoats, and the interrupted lines the Waddington series recorded by Williamson.

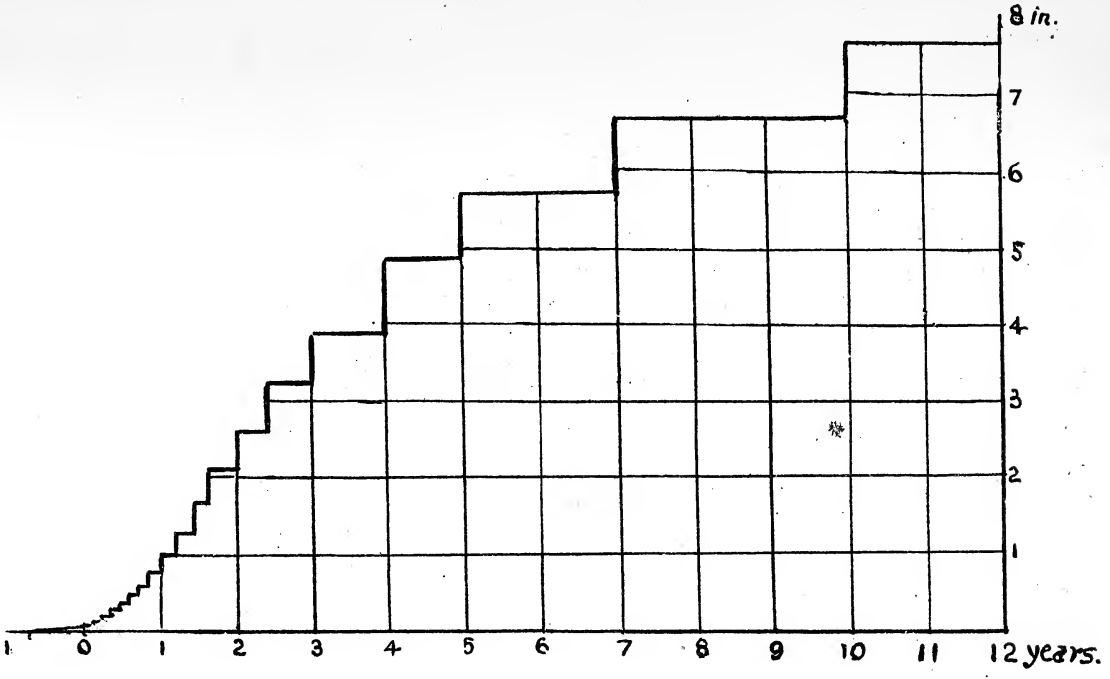


CHART IX.

An approximate suggestion as to the growth of the crab.

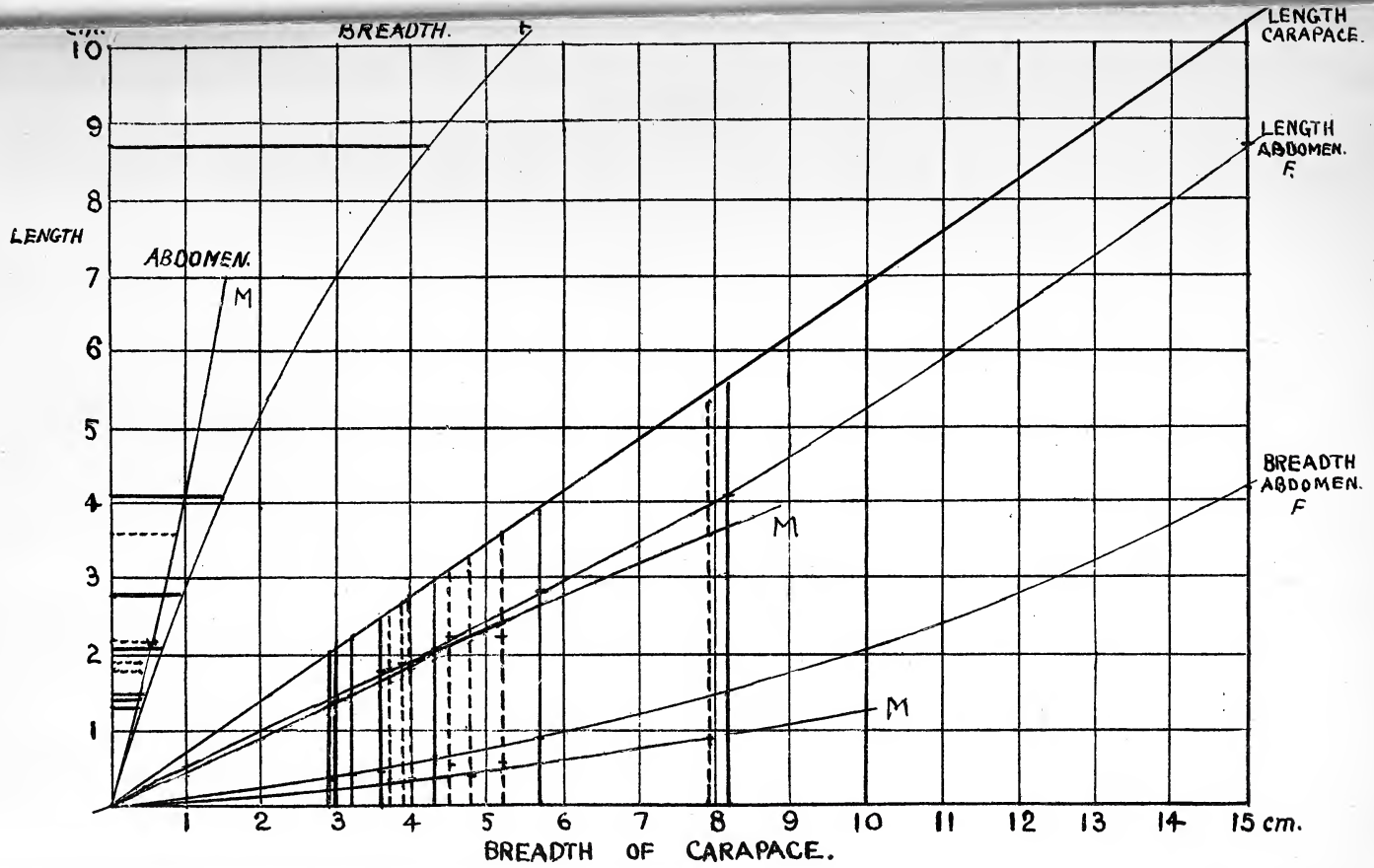


CHART X.

Relative growth of Carapace and of Abdomen of crab — *Cancer pagurus*,
M. = male, F. = female.

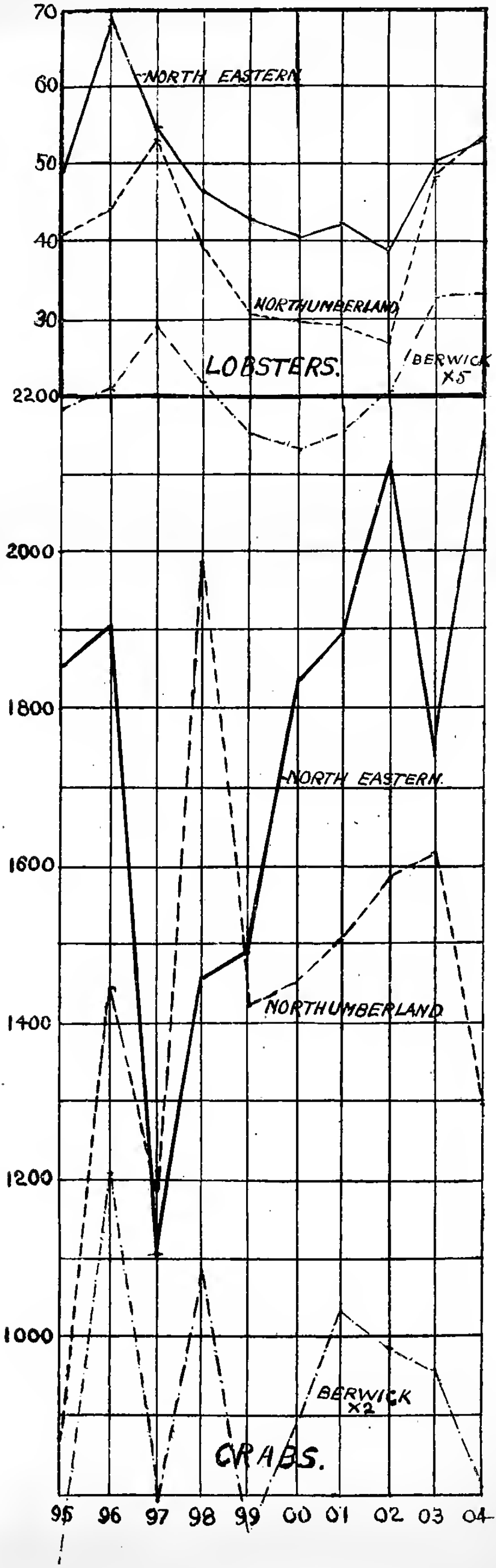


CHART XI.

Catches of crabs and of lobsters (in thousands) from 1895 to 1904, in the Berwick or Eyemouth district of Scotland, and in the Northumberland and North-Eastern districts of England.

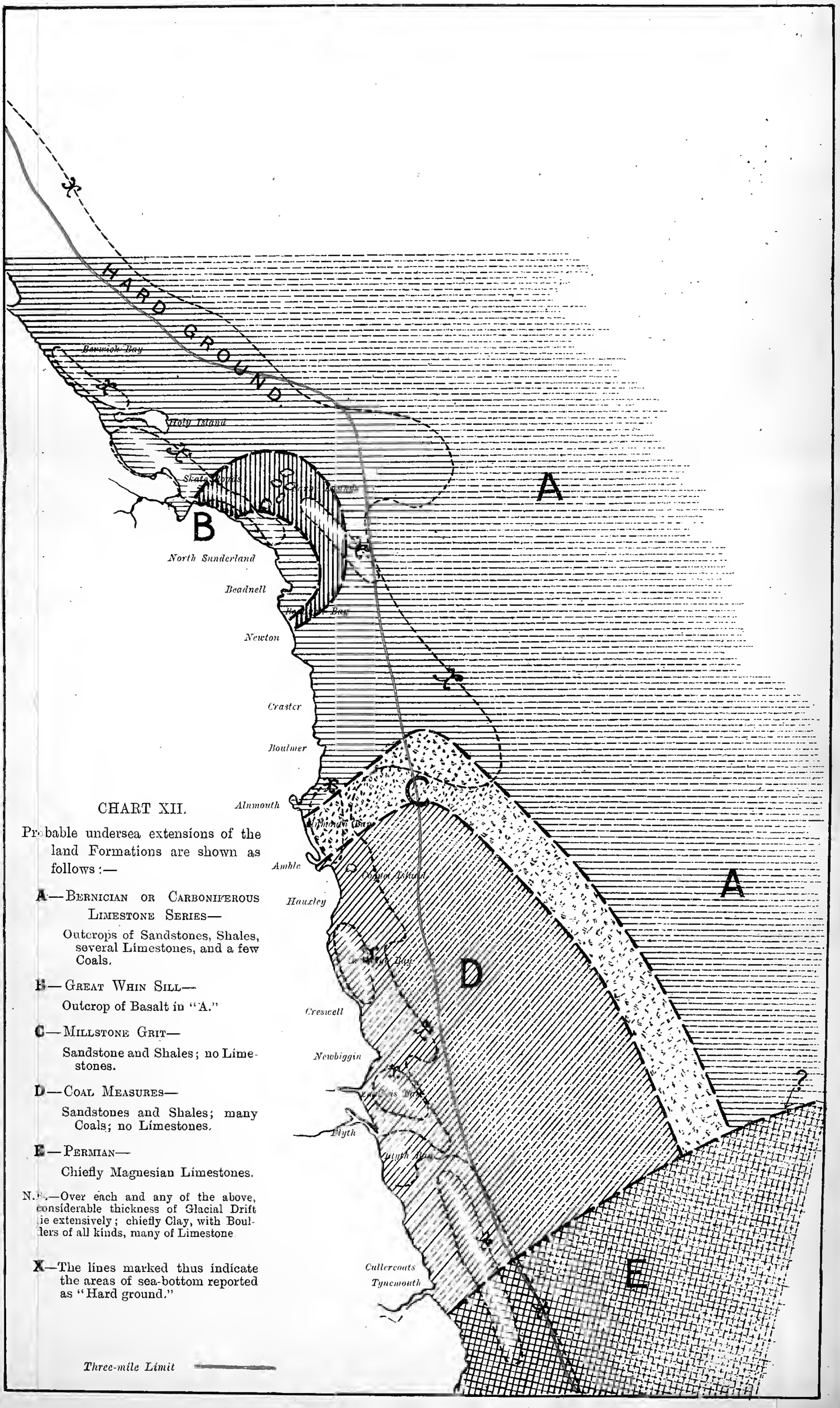


CHART XII.

Probable undersea extensions of the land Formations are shown as follows :—

A—Bernician or Carboniferous Limestone Series—

Outcrops of Sandstones, Shales, several Limestones, and a few Coals.

B—Great Whin Sill—

Outcrop of Basalt in "A."

C—Millstone Grit—

Sandstone and Shales; no Limestones.

D—Coal Measures—

Sandstones and Shales; many Coals; no Limestones.

E—Permian—

Chiefly Magnesian Limestones.

N.B.—Over each and any of the above, considerable thickness of Glacial Drift lie extensively; chiefly Clay, with Boulders of all kinds, many of Limestone.

X—The lines marked thus indicate the areas of sea-bottom reported as "Hard ground."

Three-mile Limit ——

The statistics show that the general manner of fishing is much the same at all the stations, but there are more crabs caught towards the end of the year in the northern division, and more lobsters in the southern.

The season as a whole is an early one for crabs, but it is in April that it attains its highest degree of success. This is more than probable, from the analysis we have already made, not altogether because the crabs are to be caught in April in larger quantities per pot, but to the habits of the fishermen. A great deal of line fishing is still indulged in during the early months of the year, and in certain parts of the district the access to the markets allows of the fish being sold to better advantage than by using them to bait the creels. Crab fishing is much more vigorously pursued in the northern division, and as is apparent an earlier start is made. After April there is a considerable decline in the catches, but this is also true if less intense of the southern district. This is due to the natural decline pointed out before, but also to the fishermen at a time when the crab fishing is at a low ebb turning with advantage to the herring or the trout and salmon fishing.

It is evident, moreover, that the two divisions of the County differ in a remarkable manner as to the relative quantities of crabs and lobsters caught. (Charts V. VI. and VII.) At all times of the year more crabs are captured in the northern division, but particularly at the beginning and at the end of the year. On the other hand the catches of lobsters are very much the same for the two districts. In other words there are more lobsters caught in the southern part of Northumberland in comparison with crabs than in the northern. I have already referred to this*, and gave then the proportions for the years 1895-1900. For the succeeding years the proportions of lobsters to crabs are:—Northern District—1901, 1/70; 1902, 1/90; 1903, 1/46; 1904, 1/33. Southern District—1901, 1/30; 1902, 1/33; 1903, 1/20; 1904, 1/13. The first two years of the period now given are not very different from the preceding six years in the case of the northern district, but for the same years the proportion is decidedly less for lobsters in the southern, and the last two years show that a noteworthy change has occurred coincident with the general increase in the catches of lobsters.

* Rep. Northumberland Sea Fisheries Committee for 1900, p. 46.

5.—GEOLOGICAL CONSIDERATIONS.

The conspicuous success (Chart VII.) of the crab in the northern division of the County, I am persuaded is closely connected with the geological conditions. At all the stations, the men know that the crabs from a hard bottom are, as a rule, of better quality than those from a soft bottom. Now it is a fact that the crabs in the northern district are not only much more numerous, but taken as a whole of better quality than those of the southern, and it is a fact likewise that the hard ground is much more extensive and extends further to sea in the former region.

The great areas of hard ground permit of more extensive movements on the part of the crabs in the northern half of the County. Their migrations are wider, greater dispersion occurs, and this means there is a larger extent of feeding ground at their disposal.

The soft ground is much nearer the coast in the southern district, and limits migration and the available feeding space. It follows that the depositions of mud from the Tyne at the southern limit of this latter district will tend to further contract the hard ground.

The crabs appear, moreover, to differ to some extent in size in different localities, and in some places a segregration of sex is said to characterize various grounds.

On the other hand, the more littoral rocky ground of the southern half of the County is about equally favourable to lobsters as the northern, and the fact offers a physical proof of the conclusions with regard to the migration of this form which we have arrived at from experiment.

To illustrate this point, I made enquiries as to the extent of the hard ground off the Northumberland coast, and indicated its limits on a map of the district, which is here reproduced (Chart XII). It is only approximately correct, but its value has been greatly increased from additions to it made by Professor Lebour, showing the probable trend of the formations under the sea, and with regard to this he has written the following note:—

"On the accompanying map, an attempt has been made to indicate the probable position of the outcrops of the various geological formations beneath the surface accumulations upon the sea-bottom for some miles east of the coast line. It is possible that some of the tracts reported by dredgers as consisting of "Hard Ground" may actually be occupied by portions of these outcrops *in situ* kept bare by current action, but for the most part these areas are, there is reason to believe, covered rather by detached fragments of the outcrops over which they lie, together with other fragments carried by current action some

distance from the parent rock (probably from north to south), and mixed with boulders of all kinds from the boulder clay which abounds on the land adjoining, and with pebbles from the glacial gravels and sands which cap the clay.

"Of the boundary lines shown, those exhibiting the undersea extension of the Great Whin Sill are the least doubtful, and that separating the Carboniferous from the Permian the least certain.

"It must be clearly understood that, except as regards the Whin Sill, though the general relations and trend of the stratigraphical boundary lines are drawn with some confidence, their exact position is and must probably ever remain doubtful.

"It may be added that some miles seaward of the area depicted, a deposit of Tertiary beds of Pliocene (Crag) Age very probably overlies the older rocks unconformably."

6.—LIFE HISTORIES.

Statements have been made in previous reports as to what was known with regard to the life histories of the crab and lobster. It will be useful to present briefly the main facts.

1.—Number of ova borne by the Female.—In the case of the American lobster, Herrick determined the number of ova borne by the female in 4,645 examples, measuring from 8 to 19 inches. The number varied from 3,045 to 97,440, the average for each size being 4,822 to 77,647. Our lobster appears to be very similar and the number of ova borne by the berried female may therefore be said to be on the average about 40,000—it being understood that the number of ova carried by the female increases with the size of the lobster.

In the report for 1899 there was published an estimate of the number of ova on a berried crab, viz., about 1,000,000. Williamson found in 6 examples, varying from $5\frac{3}{4}$ to $7\frac{11}{16}$ inches, that the number of ova was from about 460,000 to 3,000,000, and that in this case it was true also, the larger the crab the greater the number of ova. Other determinations have been made which show that it may be assumed that the berried crab carries on the average about 1,000,000 ova.

2.—Spawning Season.—Ehrenbaum found the spawning season of the lobster at Heligoland to be mid July to mid September. Fullarton's observations proved that the season was much the same for Brodick. On our coast it is not likely to be much if at all different. Newly spawned lobsters have been found in July and August.

The crab, as is now well known, spawns during the months November to January and possibly the beginning of February.

3.—Hatching Season.—Both Ehrenbaum and Fullarton have given July to September as the hatching season of the lobster. I have found the lobsters on this coast to hatch principally about the end of June, in July, and up to the end of August, and the season on this coast may be said to be therefore June to August or September.

The hatching season of the crab is from July to the beginning of October. A December spawner hatched during the first week of August, and a November spawner early in July at Beadnell.

The incubation period of the crab is therefore one of about 8 months, that of the lobster, as Fullarton showed, about 11 months.

4.—Young Stages.—The larva of the lobster is pelagic immediately it leaves the egg and continues so for about three weeks, during which time it moults four times, loses the swimming branches of the pereiopods, gains its abdominal appendages, and becomes distinctly lobster-like. At the end of this period it becomes demersal in habit.

The early life of the crab is not so definitely known, but there is about a month of the stage called the Zoea, and during this time the cuticle is cast evidently four times. It changes next to the megalopa which leads at another moult to the more distinctly crab-like and demersal stage.

In both cases, the currents will bring some of the young stages into favourable and others into unfavourable situations, thus affecting the rate of growth and the degree of survival.

5.—Growth.—The cuticle is cast many times during the first year, and thereafter at gradually increasing intervals of time, subject however to seasonal variation, until the growth is completed.

(*A*).—Lobster.—The American lobster according to the experiments of recent years* grows to about $1\frac{1}{4}$ inches in 3 months from hatching; it reaches 2 inches on an average in 10 months, and at 1 year is about $2\frac{1}{6}$ inches; at 17 months it measures about $3\frac{1}{2}$ inches; at 2 years, $4\frac{1}{2}$ inches; and in 3 months more, $4\frac{7}{8}$ inches. There is much variation in the size reached at a given age, but the averages are based on a good number of examples. Another year's experiments showed that American lobsters may grow to $2\frac{7}{8}$ inches in a year, and to $4\frac{1}{2}$ inches in 16 months.

With regard to our lobster I have to record an interesting specimen which was caught at sea this year in the surface net. This was at Alnmouth Bay, at one of the trawling experiments, on

* 32nd and 33rd Ann. Reps. Com. of Inland Fish., 1902, 1903.

the afternoon of September 7th. This young lobster measured 20·5 mm. ($\frac{13}{16}$-inch). It may be said to be about 2 months old. Another specimen in my possession was obtained on March 20th, 1900, at Cullercoats—a male, measuring 76 mm. (3 inches). This one might be 8 to 9 months or a year later in age. At this rate it will be about 4 or 5 years before maturity is reached. The American lobster comes to maturity at about 9 to 10 inches, and Fullarton came to the same results. On our coast the females are usually 10 inches and over, when in the berried condition, but I have had examples measuring $9\frac{1}{2}$ and $9\frac{5}{8}$ inches.

(*B*).—Crab.—Two years ago with the aid of three of the excellent series of stages prepared by H. J. Waddington, Esq., Bournemouth, I published a paper on the Growth of the Shore Crab*. I intended to print at the same time the conclusions I had arrived at with regard to the growth of the edible crab, but, feeling that my facts were all too inadequate, I withheld the latter portion of the paper in the hope that I would be able to obtain more information on the subject.

With the aid of a grant from the Royal Society I had made a strong iron tank which was placed in the concrete receptacle already available on the rocks near spring tide low water mark, and hatching boxes and a large observational tank for the laboratory. I have not to remind those interested in the laboratory that the latter, with the experiments then in progress, was destroyed by fire last Easter. In the meantime Williamson** has published a paper on the subject based again on series of the edible crab furnished by Mr. Waddington, and now I think it advisable to state to what extent my enquiry reached when it was brought to an end by the fire.

On the accompanying chart (Chart VIII.) the thick lines mark the ecdyses which took place at Cullercoats. I have ventured to introduce into the chart the three series of stages from Mr. Waddington's experiments detailed by Williamson. These are distinguished by the interrupted lines in the lower part of the chart. The year of the crab's life is supposed to begin on the 1st August. It is quite clear from the chart that the small crabs which appear on the rocks about April, increasing in numbers up to July and August, and disappearing again about the latter end of September, are crabs beginning their second year and include some beginning their third year. In other words the small crabs of 1 inch to $1\frac{1}{2}$ inches whose ecdyses are shown may be said to be 1 year old. But the variation

* Rep. Northd. Sea Fish Com., 1902. ** 22nd Rep. Fish Bd. for Scot., 1904.

is much larger than that stated, as is apparent from the diagram. The growth of the crab which completed its second year in the Waddington series was plainly retarded by confinement. It is more than likely that a crab of 1 inch at the end of its first year would be about $2\frac{1}{2}$ inches at the end of the second year. Such a crab would reach a size of about $3\frac{7}{8}$ inches at the end of the third year. At this period the cuticle is evidently not cast until the autumn of the next year as is apparent from the following example which is also shown on Chart VIII. A female measuring $3\frac{3}{16}$ inches was obtained at the end of May, 1903, and was kept in the laboratory until the ecdysis which took place during the night, July 29-30. Early in November this crab, which then measured $3\frac{5}{8}$ inches, was transferred to the tank on the rocks where she was found to have cast about August 1st this year. Unfortunately, through a slight accident to the framework of the tank, she effected her escape and the size gained after the last ecdysis was not determined, but she appeared to be about $4\frac{3}{4}$ inches. The ecdysis at the end of the fourth year thus brings the crab we are considering to a size of about $4\frac{5}{8}$ inches. It is also very probable that sooner or later, after the lapse of another year, another ecdysis will occur, the size now being about $5\frac{3}{4}$ inches. As regards this period of the life of a crab it has to be recalled that the gradual diminution in the rate of growth renders it unlikely that the size will be altered at the end of the next year. I have had before to record examples of crabs which certainly could not have cast every year. One of these (*vide* Report for 1898) was a female measuring $5\frac{1}{4}$ inches. This crab cast on August 12th, attaining a size of $6\frac{5}{8}$ inches. She was hard in December and was retained until June when she died. This crab would more than likely have come into berry at the end of that year and would not have cast therefore until the lapse of two years. There is now in the rock tank a crab got from Beadnell on November 5th, 1903, measuring $6\frac{9}{16}$ inches. She was hard but she did not come into spawn until end of December, 1904. It is evident that this crab will not cast until the autumn of 1905. This is a period of three years since the last ecdysis. The female also shown in Chart VIII., measuring originally $5\frac{11}{16}$ inches, and which cast on September 17-18th, 1903, and then reaching the size of $6\frac{9}{16}$ inches, has not cast at all in 1904.* The same conditions, it may be remarked, hold good with regard to the lobster (*vide* Rep., 1901, p. 43.)

*See also Williamson, 22nd Rep. S. F. B., p. 136, 1904.

With these considerations in mind I have indicated alongside Chart VIII. the number of years which may be supposed to be necessary for the growth of such a crab, and I have in Chart IX. expressed the growth of this crab. I do not venture to suggest that it conveys an absolutely correct picture of the growth of the crab, but I offer it as an indication of Crustacean growth in general, based however on the facts so far as we possess them for the crab, *Cancer pagurus*.

The female has been particularly considered in arriving at the above conclusions, but the male is evidently liable to the same laws of growth, and, although it is probable that the rate of growth is greater in the case of the male, it is not at all likely either that the male casts regularly every year after maturity is attained. It must be remembered that the growth is subject to a great deal of variation, both of external and internal origin, and, from what has already been said with regard to the difference between the North and South divisions of the County, it may be inferred that the rate of growth will be on the whole somewhat greater in the northern district.

Another point deserves to be pointed out, and it is that the sperms of the crab may remain in the spermathecæ of the female for two or three months more than one or two years, and perhaps in the case of the larger females for over three years, before being used for the fertilization of the ova.

In my previous unpublished attempt to state the growth of the crab I had the privilege of analysing the carefully measured series which Williamson collected at Dunbar, the details of which he has since published*. I beg to take this opportunity of thanking him for his kindness in letting me have the use of his table, and I may be allowed to add that the conclusions arrived at then were not very different from what have been stated above.

The female crab may become mature at a size of $4\frac{1}{2}$ inches, but she usually measures 5 or $5\frac{1}{2}$ in. before spawning. It is probable therefore that the female crab is five years old at maturity.

The following table gives the measurements of the ecdysed cuticles referred to. Only a few convenient measurements have been made with a view to stating some of the facts of regional growth. In the case of the chela the columns headed 1 and 2 refer to the measurement (1) of the external border of the dactylopodite and (2) of the internal border of the propodite.

* 22nd Rep. S. F. B., 1904.

TABLE XVIII. Measurements, in centimetres, of Ecdysed Cuticles of *Cancer pagurus*.

DATE OF ECDYSIS.	SEX.	CARAPACE.		ABDOMEN.		CHELA.			
						LEFT.		RIGHT.	
		Length.	Breadth.	Length.	Breadth.	1	2	1	2
Sept. 24-25 ...	F.	2·2	2·9	1·3	0·4	0·6	1·2	0·6	1·2
August 16-17 ...	F.	2·1	2·9	1·4	0·4	0·55	1·2	0·55	1·2
Aug. 31-Sept. 1	F.	2·2	3·0	1·4	0·4	0·6	1·2	0·6	1·2
September 3-4	F.	2·3	3·2	1·5	0·45	0·7	1·3	0·6	1·2
September 5-6	F.	2·3	3·2	1·5	0·45	0·7	1·3	0·7	1·3
October 11-12...	F.	2·6	3·6	1·8	0·5	0·7	1·4	0·7	1·4
Sept. 17-18 ...	M.	2·6	3·7	1·8	0·4	0·8	1·5	0·7	1·6
July 26-27 ...	M.	2·8	3·9	1·9	0·4	0·8	1·6	0·9	1·6
October 12-13...	M.	2·9	4·0	1·8	0·4	0·9	1·7	1·0	1·7
July 24 ...	F.	3·0	4·3	2·1	0·7	0·8	1·8	0·9	1·8
July 31-Aug. 1	F.	3·1	4·5	2·2	0·6	1·0	1·8	0·9	1·8
July 31-Aug, 1	M.	3·3	4·8	2·2	0·45	0·9	1·9	1·0	1·9
July 28 ...	M.	3·6	5·2	2·2	0·6	0·9	2·0	1·2	2·2
August 17-18 ...	F.	3·9	5·7	2·8	0·9	1·2	2·4	1·2	2·4
September 8 ...	M.	5·3	7·9	3·6	0·9	1·7	3·3	1·6	2·9
July 29-30 ...	F.	5·5	8·2	4·1	1·5	1·9	3·5	1·8	3·5
*August 1 ...	F.	6·9	10·0						
Sept 17-18 ...	F.	10·3	15·0	8·7	4·2	3·6	6·6	3·8	6·8

* Carapace only—succeeding stage to preceding at an interval of a year.

It would be straining the principal objects of this paper to refer to the measurements in detail, and they are few, because they have been purposely confined to the ecdysed cuticles in my possession. But in Chart X. those referring to the carapace and abdomen have been conveniently brought together. It is only necessary to draw attention to the fact that the length of the carapace bears a constant relationship to the breadth. The angle is 34° and the relationship may therefore be said to be about ·68 : 1. The difference in the

development of the abdomen in the two sexes, the acceleration in growth of that of the female, the retardation of that of the male is shown in each case in relationship to the carapace, and on the left of the chart the breadth as compared with the length. There is not much difference in the case of the two chelæ in the young state, but the variation increases with age, and the variation appears, as we should expect, to affect the male more than the female.

6.—Migrations.—So much has been done in our own district and so recently reported upon that a word is only necessary now under this head. The crab leaves the coast for the deeper and often extra-territorial waters in the autumn, returning gradually to the shore again in the spring, although it has been shown both by Williamson and as a result of our own experiments, that the crab at the same time may also migrate to some distance from its original location. So far as has been seen, this is always in a northerly direction. Crabs, said usually to be old and black, are occasionally caught by trawlers at considerable distances from the shore, so that they appear to migrate sometimes very far in that direction as well. It is not easy to explain this, though it may be that the blackness is caused by the soft ground so general off the coast.

As has been said already the crab of the Southern District has not so much room for migration as that of the North, but we have no definite facts yet as to how far the soft ground really affects the migratory movements.

Lobsters also migrate to a slight degree in the winter months, but as a rule do not go very far from the inshore hard ground, and the berried lobster appears to remain altogether inshore. In spite of this general rule we are told that on hard ground, many miles from the land, lobsters are sometimes caught by trawlers. I should like to get one or two of them with details as to localities of capture.

I may also take this opportunity of stating that further experiments are being made on the Northumberland coast to obtain some more facts with reference to the migrations of crabs. The labels bear the letter N followed by a number and are tied to one of the large claws (chelæ).

7.—POPULATION.

1.—Lobsters.—The average annual catch of lobsters on the coast of Northumberland, according to the statistical returns for the ten years ending 1904, is 39,555, say 40,000.

In 1902* Mr. Douglas, Beadnell, labelled and liberated 100 lobsters and 12 were recovered. But this percentage is more than likely too small, for of one group of 10, 8 were recaptured, and we have reason for believing that some of the labels were destroyed through ignorance. The fishing strength of the fishermen may be estimated to be about 20 per cent., and any other losses so far as the mature lobster is concerned must be so small as to be negligible. The population of adult lobsters on the Northumberland coast may therefore be said to be about 200,000.

From the considerations on page 43 it appears that the relative numbers of the sexes are, males, 42; females, 58; the latter including 19 in the berried or spawn-bearing condition.

Our 200,000 lobsters may therefore be said to consist of 84,000 males and 116,000 females, of which latter 38,000 are berried or ova-bearing lobsters.

If we may be allowed to assume then that there are 38,000 berried lobsters in the population of the Northumberland coast, and that each of these hatches 40,000 larvæ, the total annual contribution of larvæ is 1,520,000,000.

We have estimated, however, that to keep up the adult population an annual survival at maturity, or about five years after hatching, of 40,000 is demanded. This is a survival of 1 in 38,000, or ·003 per per cent.—1 lobster for each berried female.

2.—Crabs.—In similar manner the average annual catch of crabs on the Northumberland coast, for the ten years ending 1904, is 1,437,136, say 1,500,000.

In 1903† Mr. Douglas liberated, after marking, 145 crabs, and 14 were recovered, 9·7 per cent. The proportion is more than probably too small for the same reasons as in the case of the lobster. For example out of one lot of 32, 6 were recaptured. It may also be stated that the whole experiment did not take up a year, and the crabs used had recently cast. Williamson only obtained about a 10 per cent. return of the crabs he had marked at Dunbar and neighbourhood, and more than likely for the same reasons the recaptures do not in his case either, accurately measure the fishing strength of the fishermen. We may be allowed to assume again that the fishermen are liable to catch about 20 per cent.

* Rep. Northd. Sea Fish. Com., 1902, p. 40.
† Rep. Northd. Sea Fish. Com., 1903.

In the case of the crab there is reason to believe that the adults are more liable to destruction when they are soft. It is impossible to state to what extent, and for our purpose it will be convenient to assume that the 20 per cent. includes the losses from this cause, and from the captures made by the trawlers in the winter. If we assume that 100,000 are thus lost the population of crabs may be estimated to be about 8,000,000.

On page 41 it was shown that the proportion of the sexes appears to be males, 48; females, 52. It is a fact, however, to which attention has been drawn in this paper that very few berried females are accounted for in the catches of the fishermen. The principal reason is that the berried female could not easily find her way into the crab pot. Were it not for this unavoidable error in the figures at our disposal, it is more than likely that the figures would be more nearly approximate to those given for lobsters. Under the circumstances it may be allowable to assume that the proportion of males is 46 and females 54, the latter including say 18 in the berried condition.

The 8,000,000 crabs may thus be said to consist of 3,680,000 males and 4,320,000 females, of which latter 1,440,000 are berried.

Each berried crab may be said to liberate 1,000,000 larvæ, and the total annual contribution of larvæ would be therefore about 1,440,000,000,000.

Maturity is reached in about five years, and the annual survival to this period would require to be 1,600,000 to keep up the population. This would mean a survival of 1 in 900,000, or about again one crab to each berried female.

Whatever may be said for or against the assumptions in the above calculations there is no denying the fact that the death-rate in both species is a very heavy one, and particularly so in the case of the crab.

Perhaps the most serious objection, apart from criticisms of the estimation of the fishing strength, which may be urged against the figures, is that the district is regarded as being self-contained, whereas it is probable that an east-coast district like ours depends upon the slightly more northern portion of the coast for some part of its annual supplies of young stages. It is impossible to state to what extent this is true or of importance, but the differential legislation on the east coast offers a chance, after the lapse of a number of years, of indicating how far one district may be dependent upon another.

8.—REGULATION AND IMPROVEMENT.—The larvæ of both the species are very efficiently protected during the months of hatching, but immediately after hatching there succeeds a period of loss, very intense at first, but gradually becoming less severe. The retiring habits of the lobster bring about finally a practical immunity from natural enemies, but the crab continues to be subject to some degree of danger from its own species and other animals when in the soft condition. The proportion of losses from this cause will also however gradually decrease with the attainment of size.

The resources are very great, but a heavy toll is exacted. It is not at all unlikely also that the death-rate will be directly proportional to the number of the larvæ and the young stages. If it be, therefore, impossible by the act of man to exterminate such forms, it has to be admitted that the fishing will locally decline if the feeding grounds should from any cause become restricted, which it may be suggested has resulted by the deposition by the hoppers of mud in great quantities from the rivers of maritime importance. It will decline if more of the adults are removed than are being naturally contributed, and possibly also if the catching of the marketable brings about a great destruction of the unmarketable and the smaller stages, or if a heavy proportion of spawning females be caught.

These are the points of importance with reference to the present enquiry, and they are the considerations which have had weight in guiding attempts to regulate the crab and lobster fisheries by legislation.

An Act, applying to Scotland only (9, Geo. ii., 33), was passed to give a close time for lobsters during the months June, July, and August, but it has evidently been allowed to lapse. I am indebted to Mr. Wilkinson, Clerk to the Northumberland Committee, for the following excerpt:—

Section IV. And Whereas the destroying the fry or spawn of any fish is highly prejudicial especially such fish as do not wander but keep about the coasts And Whereas the principal time for the spawn of lobsters is from beginning of June to 1st September in which three months the lobsters crawl close to the shore to leave their spawn in the chinks of the Rocks and as much under the influence of the sea as possible Be it Therefore Enacted by the Authority aforesaid that from and after 1st June 1736 no fishermen etc. shall take kill or destroy any lobsters on the sea coast of that part of Great Britain called Scotland from 1st June to 1st September under penalty of £5 sterling for each offence

Modern legislation is based in the Oyster, Crab, and Lobster Act, 1877, which gives protection to crabs measuring less than 4¼in. across the back, to soft and to berried crabs (except it can be proved that they were to be used for bait), and to lobsters under 8in. in length. The Act is open to the criticism that it protects to a large extent what was already protected. There is practically no value in the crabs and lobsters under the sizes named, and on our coast and the East Coast of England as a whole the small and soft crabs are not used for bait. The berried crab, at all events with the apparatus now in use for catching, does not require protection. The berried lobster was not protected because of the greater value of the species and the special value of the berried female.

The limitations of the Act have led certain of the District Committees of England to pass bye-laws to further control the Fisheries.

The size limit for lobsters has been raised to 9in. in both the Northumberland (1899) and the North Eastern districts (1896), and also in the Southern, Devon, Lancashire and Western, and Cumberland districts.

The berried lobster has been protected by the Northumberland Committee (1899) for the months of April to July inclusive, and for all the year by the Eastern (1895), and also by the Kent and Essex, the Lancashire and Western, and the Cumberland Committees.

The minimum size for crabs has been raised to 5in. by the Southern, Devon, Cornwall, and the Lancashire and Western Committees.

The crab, locally known as the whitefooted crab, which is a crab in the process of becoming hard after casting, is protected from 1st November to 30th June by the Eastern Committee, and the soft lobster is also protected in that district.

The bait reservation has been withdrawn by the North Eastern and the Eastern Committees.

In the North Eastern district (1896) there is also a bye-law giving a close time for crabs from 1st September to 31st January.

It is not easy to judge from the statistical evidence at our disposal whether overfishing does occur, but the efforts at legislation which have been briefly reviewed above, have resulted from the complaints made by the fishermen who are convinced that considerable depletion has occurred, and their statements have been particularly strong and emphatic with regard to lobsters. The

conferences with the fishermen on the Northumberland coast have shown that a great change has taken place in the crab and lobster fishing during the past 30 or 40 years. About 1870 the old habit of fishing with separate pots, placed not nearer to each other usually than 18 fathoms, was being given up for fleets of pots only 10 fathoms apart, and the autumn crab fishing was begun. The difficulty in obtaining bait and the increased work demanded ashore by the line fishing, together with the good prices to be obtained at that period for crabs tempted more and more of the fishermen to follow the example of those who had evidently made a successful change. At first the results were satisfactory, but "more gear after some years was found to be necessary. Even with that to-day the fishing is not so productive, and especially the autumn fishing, which is a very unprofitable one, so that we are finding some of the fishermen again voluntarily going back to the line fishing, and many others willing to do so were it not for their neighbours. The returns in price, the fishermen confess themselves, are now not so good as formerly. The gear is expensive and does not last very long. Besides storms sometimes cause a great deal of loss during the autumn. The fishing itself is very destructive; so many soft crabs are got in the pots that even with much care in the selection those sent to market are so inferior that the merchant in many cases refuses to have more sent to him. It is the time of year moreover when the deterioration which is admitted takes place."*

This is what has accrued from conferences with the fishermen for a number of years with reference to crabs. In the case of lobsters, many of the fishermen are so convinced of the diminution which has taken place in connexion with the modern increase in the catching power that they would welcome a further extension of the restriction for the preservation of the berried female, and indeed a few already without waiting for legal action always carefully return the berried lobster when caught. From the preceding sections it is plain that this entails a considerable sacrifice.

In the absence of other evidence, and as they are the only ones really concerned, and the ones to suffer from any restrictions, the fishermen certainly have the right at least to express their opinions. It is because of these that the legislation now in force has been brought about. It is true also, if mistakes have been made, that experimental legislation has a certain value. And as

* Report Northd. Sea Fish. Com., 1899.

it happens that the laws in force in our district are very different from those to the north and the south, it is desirable and may be useful to contrast the results for these areas of the coast before the question of regulation be further discussed.

The following tables exhibit the catches of crabs and lobsters in the Northumberland, the North Eastern, and the Eyemouth (Scotland) district.

TABLE XIX.—NORTHUMBERLAND DISTRICT.

Number of crabs and lobsters landed within the district during the years 1895 to 1904 inclusive.

Year.	Crabs. No.	Lobsters. No.
1895	872,133	40,621
1896	1,436,404	44,332
1897	1,186,371	51,965
1898	1,980,438	39,077
1899	1,429,577	31,716
1900	1,452,975	29,807
1901	1,509,454	29,004
1902	1,583,043	26,973
1903	1,626,220	48,485
1904	1,294,745	53,577

TABLE XX.—NORTH-EASTERN DISTRICT.

Number of crabs and lobsters landed within the district during the years 1891 to 1904 inclusive.

Year.	Crabs. No.	Lobsters. No.
1891	1,744,858	26,304
1892	1,607,434	34,134
1893	1,981,289	44,451
1894	2,041,522	42,827
1895	1,853,248	49,405
1896	1,902,406	68,908
1897	1,104,839	54,512
1898	1,463,511	46,555
1899	1,489,691	43,562
1900	1,832,905	40,368
1901	1,895,986	42,998
1902	2,140,755	38,792
1903	1,754,403	50,246
1904	2,158,604	53,252

TABLE XXI.—BURNMOUTH, EYEMOUTH, AND ST. ABBS DISTRICT.

Number of crabs and lobsters landed within the district during the years 1891 to 1904 inclusive.

Year.	Crabs. No.	Lobsters. No.
1891	274,600	4,700
1892	362,000	4,300
1893	381,900	6,450
1894	414,500	5,600
1895	356,800	3,400
1896	604,100	4,200
1897	394,700	5,400
1898	543,400	4,400
1899	376,500	3,000
1900	445,400	2,600
1901	516,300	3,300
1902	493,400	4,100
1903	480,300	6,600
1904	400,900	6,657

The figures for the North Eastern district were kindly furnished by the Clerk of the North Eastern Committee, and those for the Eyemouth district by the Fishery Officer through Mr. Buglass. The statistics for each of these regions are shown graphically in Chart XI. (and for the two divisions of Northumberland in Chart VII). To bring the Eyemouth catches into relationship with those for the other two districts in Chart XI. the numbers of lobsters have been multiplied by 5, and those of crabs by 2.

There is no restriction with regard to the berried lobster in Scotland and in the North Eastern district, but in Northumberland the berried lobster has been to a large extent protected since 1899. All these areas have nevertheless participated in the general improvement which has characterised the last two years, and it would be premature therefore to claim that the local bye-law was accomplishing the good which was anticipated. All that can be said is that Northumberland shows a slightly more enhanced increment than the neighbouring parts of the coast, and that the next few years promise to be interesting as indicating more clearly the effects of such legislation.

On the other hand, with regard to crabs, there is a great similarity in the results of the fishing in the Eyemouth and Northumberland districts, and a contrast between these two and the North Eastern area, which leads to the impression that the close time in the latter district has been accompanied by good results. It is clear that since the close time was imposed in 1896 the catches of crabs have pretty steadily improved, and it must also be remembered that the catching season is contracted by five months.

Our attempt to secure a close time for Northumberland during the season when the fishing is already at a low ebb and when the soft crabs are so much in the majority, when moreover the catches include so many of the females about to spawn, met with failure because a great deal of the fishing at this period of the year is done particularly in the northern division of the county outside the territorial waters. The contingency argues in favour of the extension of the limits, and it argues also for the change desired both by the Northumberland and the North Eastern Committees that the law should make the landing and sale and possession prosecutable.

If the fishermen's contention that the crab fishing is deteriorating is admitted, and they are agreed that further legislation is necessary, there is no other way of legislative interference than by imposing a close time from the beginning or at latest the end of September to the end of the year. By preventing fishing during this period, not only the soft crabs, but more important still, the crabs about to become berried are protected. It is argued very frequently that the raising of the size to the biological limit ought to be the object of legislation, but it is open to question whether this is always the logical view of the situation. In the case of the crab this would mean raising the limit to 5 or even 5½in., and in some districts that would be a great hardship. A crab of that size would bear about 500,000 ova, whereas a full-grown crab would carry from about one to three million eggs. It would not be an act of much judgment therefore to raise the limit to a size which would give the females a chance of coming once into spawn, and at the same time to permit the catching of the far more important females of a larger size which are about to become berried. It is not clearly recognised either that the fishermen catch only a small percentage of the young crabs. I am not arguing against a size limit in general, for there are cases when it is the most desirable and effective method of interference if such be wanted, but a raising of the size limit as a means of protecting

crabs has certainly not so much to recommend it as the close time which many of the Northumberland fishermen have desired and the Committee have hitherto failed to secure.

Nothing of a constructive nature has hitherto been tried with regard to crabs. As matters are at present it has nothing to be said in its favour. The berried crab is already sufficiently protected. Hatching alone without rearing would be an entirely futile performance, as is apparent from the considerations advanced in the preceding section, and the rearing would have to be done on a scale which is not as yet demanded.

It has already been stated that further improvement with regard to the lobster fishery could only be made through the berried female. It is not likely, though desirable, that much further good would result through the berried lobster being protected for the year. And as a matter of fact the protection now given has been found to be a heavy demand upon the gains of the fishermen, so much so that it is now a far too general practice along the coast for the men to strip the lobster of its berries, and land and sell it.

A constructive method of improvement is therefore worth considering. The eggs of the lobster have been successfully hatched in hatcheries in this and other countries, and with reference to this enquiry I have to thank the directors and others for much valuable information as to the work of these establishments. A special report on the subject having been circulated among the members of the Northumberland Committee I have not now, however, to refer to this information in detail, but the following brief consideration of the question is necessary to complete the present statement.

The small survival after hatching shows only too plainly that hatching alone is foredoomed to failure. It is more than probable indeed that the already high death rate of the pelagic stage would be greatly increased from the manner of liberation of the fry, but if rearing be possible with a fair percentage of survival to a stage which has yet to be decided as being the most economical, there can be no doubt that lobster culture could be made to improve the resources of such a district as ours. This has for many years been recognised in the United States, and experiments resulting in a survival of about 50 per cent. to the demersal stage have been made on a large scale. The hatchery at Port Erin has been equally successful. Much valuable information has been gained at the same time as to apparatus and feeding.

The methods of artificial hatching which have been tried are (1) confining the berried females in a pond and allowing the larvæ to disperse in the surrounding waters, and (2) stripping the ova from the lobster and hatching them in hatching boxes or in hatching jars.

The former method besides being expensive prevents the all important rearing of the larvæ and young lobsters, and with regard to the latter it may be said that it would be better to keep the berried lobsters in special tanks, and to collect the pelagic larvæ as they are hatched. This has already been done by Williamson with success at Aberdeen. But in addition it is altogether essential that special endeavour should be made to preserve the young lobsters to the stage when they could be put into the sea with the best results.

Experiments might show, moreover, that lobster culture on a much larger scale than that contemplated would be not merely possible but profitable and easy of accomplishment.

THE MIGRATIONS OF INSHORE FISHES.

By ALEXANDER MEEK, M.Sc.

The experimental attempt to determine the migrations of the inshore fishes begun last year has been continued this.

The following Tables show the numbers liberated during 1903 and 1904, and the number recaptured to 31st December, 1904.

1903.—PLAICE.

Date.	Place.	Number Liberated.	Number Recaptured.
June 26 ...	Skate Roads	2	1
,, 26 ...	Goswick Bay	16	6
July 1 ...	Alnmouth Bay	22	2
,, 9 ...	Cambois Bay	4	0
,, 15 ...	Druridge Bay	34	4
,, 23 ...	Blyth Bay...	67	14
Aug. 4 ...	Skate Roads	42	8
,, 12 ...	Druridge Bay	40	1
,, 19 ...	Alnmouth Bay	63	1
,, 26 ...	Cambois Bay	40	0
Sept. 2 ...	Blyth Bay...	57	8
,, 9 ...	Druridge Bay	84	16
		471	61

DAB.

July 1 ...	Alnmouth Bay	8	1
,, 9 ...	Cambois Bay	1	0
		9	1

SOLE.

July 9 ...	Cambois Bay	1	0

TURBOT.

July 15 ...	Druridge Bay	1	0
	Total	482	62

1904.—PLAICE.

Date.	Place.	Number Liberated.	Number Recapture
July 20 ...	Cambois Bay	7	0

DAB.

June 24 ...	Cambois Bay	39	0
July 6 ...	Druridge Bay	71	5
,, 13 ...	Alnmouth Bay	27	0
,, 20 ...	Cambois Bay	48	1
Aug. 1 ...	Skate Roads	46	0
,, 10 ...	Druridge Bay	52	4
,, 17 ...	Blyth Bay...	54	3
,, 24 ...	Cambois Bay	44	1
Sept. 7 ...	Alnmouth Bay	51	1
?	?		1
		432	16

FLOUNDER.

July 13 ...	Alnmouth Bay	24	1
Aug. 10 ...	Druridge Bay	1	0
		25	1

TURBOT.

Aug. 10 ...	Druridge Bay	1	0
,, 24 ...	Cambois Bay	1	0
Sept. 7 ...	Alnmouth Bay	2	0
		4	0
	TOTAL	468	17

1.—THE MIGRATIONS AND THE GROWTH OF PLAICE.

(Reprinted with slight modification from the Transactions of the Natural History Society of Northumberland, &c. The Society has also granted the use of the blocks for the illustration of the paper.)

In 1893 Dr. T. W. Fulton* published the results of experiments made under the auspices of the Fishery Board for Scotland with a view to determining the migrations and rate of growth of plaice and other fishes. His conclusions with reference to plaice were :— "(1) That plaice tend to remain within the inshore waters during the period of immaturity; (2) That while they may travel 20 miles in about a year or so, their movement is as a rule slow; 3. That in the areas investigated their movement is in a definite direction, namely, inwards along the south shore of the Firth of Forth in a westerly direction, then outwards and eastwards along the northern shore, and that this general direction is continued round St. Andrew's Bay towards the north." During the years 1889 to 1892 the large number of 1,250 plaice were labelled and liberated, and of these 103 were recaptured, or 8·2 per cent. The author considered however that this proportion was more than probably too small, for the first batch of labels proved to be unsatisfactory. An examination of the details of the experiment bears out the general conclusions. A certain number certainly went to the south, and in the Firth in the opposite or other directions, but the general tendency was to go out of the Firth to the north along the coast of Fife, and from the coast of Fife to the Tay, and to the north of the Tay. Several found their way to the deeper water off the Forth and off the Tay.

In the same year, 1893, Dr. C. G. Joh. Petersen† made experiments in labelling plaice, and arrived at a method which has been adopted with some modification by subsequent experimentalists. He marked and liberated about 1,000 fishes in the Limfjord, and recovered 51, but believed that the proportion would have been increased if the fishermen had been more interested, and also that many of the labels had been lost. They were immature plaice, and

* 11th Ann. Rep. S.F.B.

† Report of Danish Biolog. Stat. 1893.

were caught again in the Limfjord. The results therefore did not show anything definite with regard to migration. The plaice made good progress in growth, however, and recently attempts have been made to transplant plaice from the North Sea into the fjord.

The staff of the Plymouth Laboratory have, in addition to the extensive experiments made in conjunction with the other North Sea powers, taken the opportunity of the trawling experiments on the coast of Devon to mark and liberate a number of plaice. The results have been published by Mr. Garstang*. During 1901 and 1902, 420 plaice were labelled, and 121 were recovered, or 29 per cent. Mr. Garstang gathers from the experiment :—(1) Plaice below 8 inches in length are practically confined to the inshore waters of the bays at all seasons of the year. (2) On attaining a length of 8 inches the plaice in Teignmouth Bay and Torbay tend to emigrate in summer into Start Bay, and in winter over the offshore grounds. He saw reason for stating that the larger plaice migrated to the offshore grounds in November and December, and returned in March and April. The district thus appears to be self-contained, but were we to look for an indication of a general movement in a definite direction, such as resulted in the case of the Scotch experiments, we would be justified in saying that if it does occur it is an up-channel one.

The opportunity was taken last year at the Northumberland trawling experiments to label and liberate a number of the plaice and a few other flat fish, and a preliminary report on the results was published†. The label used was the modified form of the Petersen label adopted in the international investigations. About 200 of the fish were marked with labels sent from the Lowestoft Laboratory, the remainder with smaller but similar labels which we got made. Each label consisted of an oval numbered brass disc, a bone button, and a short piece of silver wire. The latter was passed through the fish in the interspinous region next the dorsal, or in some cases the ventral (anal) fin, and bent to secure the button below and the disc above.

Altogether 482 fishes were thus marked and returned to the sea, after being carefully measured and in many cases weighed. The results up to December 31st, 1904, are given in the accompanying table (see pages 72 and 73).

* Jour. Mar. Biol. Assoc., Dec., 1903.
† 1903. Rep. Northd. Sea Fish. Com.

PLAICE.

Number	Date.	Length.	Weight	Where Liberated.	Where Captured.	Date.	Length.	Increase.	Sex.	Migration.
	1903	Cm.	Oz.			1904	Cm.	Cm.		
802	June 26	22·5	5	Goswick Bay ...	Skate Roads	April 5	28·2	5·7 in 284 days	m	4 miles south
						1903				
805	,,	27·3	8	,, ...	St. Andrew's Bay ...	Nov. 5	29	1·7 in 132 ,,	f	42 ,, north-west
						1904				
806	,,	22·2	5	,, ...	Goswick Bay	April 11	26	3·8 in 290 ,,	f	o
808	,,	28·5	10	,, ...	7-8 miles E. of Isle of May	May 27	33	4·5 in 336 ,,	m	35 miles north-west
810	,,	27·3	9	,, ...	Skate Roads	March 18	...	...	...	4 ,, south
816	,,	20·3	3	,, ...	Goswick Bay	...	...	...	...	o
818	,,	26·7	...	Skate Roads ...	Skate Roads	April 8	30·6	3 9 in 288 ,,	m	o
830	July 1	22·5	...	Alnmouth Bay ...	Amble Harbour	April 21	23·5	1 in 295 ,,	f	1 mile south
						1904				
842	,,	21·6	...	,, ...	Alnmouth Bay	Aug. 10	33	11·4 in 405 ,,	—	o
878	July 15	22·8	3½	Druridge Bay ...	Amble Harbour	March 24	25·2	2·4 in 253 ,,	...	5 miles north
879	,,	26	6	,, ...	Sent from London market (locality of capture unknown) on	Nov. 22	37·5	11·5 in 405 ,,	m	?
882	,,	20·6	3½	,, ...	Druridge Bay	Oct. 4	33	12·4 in 447 ,,	f	o
883	,,	18·4	2	,, ...	,, ...	July 9	22·8	4·4 in 360 ,,	m	o
890	July 23	24·1	6	Blyth Bay	Cullercoats	April 8	26·3	2·2 in 260 ,,	f	5 miles south
891	,,	22·5	4½	,, ...	Blyth Harbour	April 27	25·9	3·4 in 279 ,,	m	1 mile north
892	,,	21·6	3½	,, ...	,, ...	March 24	23·2	1·6 in 245 ,,	m	1 ,, north
893	,,	21·6	4	,, ...	Blyth Bay	April 14	24·2 ?	2 6 in 266 ,,	m	o
895	,,	25·1	6	,, ...	Blyth Harbour	March 24	25·7 ?	0·6 in 245 ,,	f	1 mile north
						1903				
913	,,	19·3	3	,, ...	Seaton Sluice	Aug. 6	...	...	...	1 ,, south
						1904				
925	,,	22·5	4½	,, ...	Blyth Harbour	April 7	25 4	2 9 in 259 ,,	f	1 ,, north
927	,,	25·4	6	,, ...	St. Mary's Island	May 26	27·9	2·5 in 308 ,,	m	2 miles south
						1903				
929	,,	20·3	3	,, ...	Between Hartley and Seaton Sluice	Aug. 20	...	...	...	1⅓ ,, south
						1904				
930	,,	23·5	5	,, ...	Blyth Harbour	March 5	23·5	0 in 226 ,,	f	1 mile north
						1903				
932	,,	20·0	3	,, ...	Seaton Sluice	Aug. —	...	...	...	1 ,, south
939	,,	23·5	4½	,, ...	Blyth Bay	Aug. 21	...	...	...	o
						1904				
954	,,	23·8	6	,, ...	Blyth Harbour	Feb. 16	...	...	...	1 mile south
956	,,	22·8	5	,, ...	,, ...	March 5	25·4 ?	2·6 in 226 ,,	m	1 ,, north

PLAICE.—Continued.

Number	Date.	Length.	Weight	Where Liberated.	Where Captured,	Date.	Length.	Increase.	Sex.	Migration.
	1903	Cm.	Oz.			1904	Cm.	Cm.		
969	Aug. 4	20·6	...	Skate Roads ...	Parton Steel	April 9	20·6	·0 in 249 days	m	1-2 miles north
975	,,	24·1	...	,, ...	Skate Roads	April 23	25·5	1·4 in 263 ,,	m	0
976	,,	23·5	...	,, ...	,, ...	April 25	26	2·5 in 265 ,,	f	0
983	,,	26·3	...	,, ...	,, ...	May 27	33	2·7 in 297 ,,	f	0
991	,,	24·1	...	,, ...	,, ...	March 10	25·4	1·3 in 219 ,,	f	0
994	,,	22·2	...	,, ...	,, ...	May 2	24·4	2·2 in 272 ,,	f	0
995	,,	26	...	,, ...	,, ...	April 9	...	...	...	0
998	,,	26·6	...	,, ...	,, ...	March 12	29·2	2·6 in 221 ,,	m	0
23	Aug. 12	28·5	10	Druridge Bay ...	Druridge Bay	April 15	30·6	2·1 in 247 ,,	f	0
88	Aug. 19	21·9	...	Alnmouth Bay ...	Alnmouth Bay	Sept. 7	29	7·1 in 385 ,,	...	0
159	Sept. 2	24·7	...	Blyth Bay	Hartley	May 3	26·6	1·9 in 244 ,,	m	1 mile south
162	,,	27·2	...	,, ...	Blyth Harbour	March 5	...	...	...	1 ,, north
178	,,	24·1	...	,, ...	Blyth Bay	Aug. 17	33	8·9 in 350 ,,	...	0
183	,,	26	...	,, ...	,, ...	Aug. 17	34·2	8·2 in 350 ,,	...	0
184	,,	27·3	...	,, ...	,, ...	April 1	28·2	·9 in 212 ,,	m	0
187	,,	22·5	...	,, ...	,, ...	May 3	22·3	– ·2 in 244 ,,	m	0
188	,,	25·1	...	,, ...	Blyth Harbour	March 22	25·4	·3 in 202 ,,	m	1 mile north
193	,,	23·2	...	Blyth Bay	Cullercoats	Aug. 1	...	...	...	4 miles south
201	Sept. 9	23·1	...	Druridge Bay ...	Druridge Bay	April 27 1903	23·6	·5 in 231 ,,	m	0
205	,,	21·6	...	,, ...	,, ...	Oct. 23 1904	22·2	·6 in 44 ,,	m	0
206	,,	24·1	...	,, ...	,, ...	Oct. 25	33	8·9 in 412 ,,	f	0
208	,,	18	...	,, ...	,, ...	May 26	18	0 in 260 ,,	f	0
216	,,	24·4	...	,, ...	,, ...	June 6	26·3	1·9 in 271 ,,	f	0
217	,,	26	...	,, ...	300 yds. S. of Bondicar ..	May 19	26	0 in 253 ,,	m	2 miles north
225	,,	22·8	...	,, ...	Druridge Bay	March 23	22·8	0 in 196 ,,	f	0
231	,,	23·5	...	,, ...	,, ...	April 20	23·5	0 in 224 ,,	m	0
235	,,	19	...	,, ...	,, ...	July 6	22·3	3·3 in 301 ,,	...	0
247	,,	22·2	...	,, ...	,, ...	June 22	23·5	1·3 in 287 ,,	f	0
251	,,	22·8	...	,, ...	,, ...	June 14	23·2	·4 in 279 ,,	m	0
253	,,	23·2	...	,, ...	,, ...	Aug. 29	30·4	7·2 in 356 ,,	f	0
254	,,	27·3	...	,, ...	,, ...	April 28	28·8	1·5 in 232 ,,	m	0
260	,,	25·4	...	,, ...	,, ...	April ?	26	·5 in 230 ,,	m	0
261	,,	22·8	...	,, ...	,, ...	April 20 1903	24·2	1·4 in 224? ,,	m	0
279	,,	25·4	...	,, ...	,, ...	Oct. 1	...	...	...	0

DAB.

Number	Date.	Length.	Weight	Where Liberated.	Where Captured.	Date.	Length.	Increase.	Sex.	Migration.
	1903	Cm.	Oz.			1904	Cm.	Cm.		
843	July 1	21·6	...	Alnmouth Bay ...	North of Coquet Island ...	April 22	21·6	0 in 296 days	f	1 mile east
	1904									
335	July 6	23·2	...	Druridge Bay ...	Druridge Bay	Sept. 19	24·8	1·6 in 75 ,,	f	o
350	,,	22·7	...	,, ...	E. by N. of St. Mary's Island in 29 fathoms ...	Oct. 10	23	·3 in 96 ,,	m	12/13 miles S.S.E.
394	,,	23	...	,, ...	Druridge Bay	Sept. 28	24·7	1·7 in 84 ,,	f	o
395	,,	21·7	...	,, ...	,, ...	Oct. 14	24	2·3 in 100 ,,	f	o
400	,,	23·2	...	,, ...	,, ...	Oct. 18	26·7	3·5 in 104 ,,	f	o
480	July 20	18·5	4	Cambois Bay ...	E. of Seaham in 31 fthms.	Oct. 20	17·8 *x*	−·7 *x* in 92 ,,	m	20 miles S.S.E.
548	Aug. 10	20	4	Druridge Bay ...	Druridge Bay	Sept. 29	21·5	1·5 in 50 ,,	f	o
577	,,	22	5	,, ...	,, ...	Nov. 1	24·9	2·9 in 83 ,,	f	o
593	,,	18·2	4	,, ...	,, ...	Sept. 28	19	·8 in 49 ,,	f	o
599	,,	25·2	8	,, ...	,, ...	Sept. 27	25·5	·3 in 48 ,,	f	o
612	Aug. 17	20·5	4	Blyth Bay	Pan Bush, Hartley ...	Sept. 27	21	·5 in 41 ,,	f	1 mile south
640	,,	21·5	5	,, ...	Blyth Bay (7 fathoms) ...	Sept. 21	21·6	·1 in 35 ,,	f	½-mile east
650	,,	22	5	,, ...	,, ...	Sept. 30	22·3	·3 in 44 ,,	f	o
689	Aug. 24	19	...	Cambois Bay ...	Cambois Bay	Oct. 15	21·6	2·6 in 52 ,,	f	o
734	Sept. 7	22·2	5	Alnmouth Bay ...	Alnmouth Bay	Sept. 28	22·2	0 in 21 ,,	f	o
+ ?	?	?	...	?	Souter bearing W. by S. in 29 fathoms	Oct. 12				?

+ Numbered portion of label lost.

x Shrunken and gutted when received.

FLOUNDER.

	1904					1904		Cm.		
434	July 13	19·5	4	Alnmouth Bay ...	1 mile South of Amble Harbour	Sept. 10	20·2	·7 in 59 days	m	1 (+) mile south

Migration.—The plaice were caught and liberated in the inshore waters of the Northumberland coast, at the various trawling stations from Goswick Bay in the north to Blyth Bay in the south. They were all immature, measuring from about 7 to about 11-in. in length. With the exception of two, the fish recovered have been captured also in the inshore waters of Northumberland, and in almost every case in the same bay where they were set free. Those recovered have been caught by the line and in trout nets, and I have therefore to thank the fishermen for their kind co-operation in carrying out the experiment. It is rather remarkable that, although it was not uncommon to catch the plaice which had just been marked in the trawl when the latter was passing over the same ground again during the course of one experiment, none of the labelled fish was caught by the trawl when the bay was subsequently revisited in the same season. Four were recaptured at the trawling experiments of 1904; 1 (No. 88) at Alnmouth Bay; 2 (Nos. 178 and 183) at Blyth Bay; and 1 (No. 235) at Druridge Bay.

The immature plaice of the inshore waters may then be said to be for the most part non-migratory. It is quite possible that much colder weather than prevailed last winter might have caused a migration into deeper water, and in such a case a return migration might have shown a general tendency in a definite direction such as resulted from Fulton's experiments. But last winter at all events the great majority of the plaice remained in the inshore waters, and did not migrate as a rule from the bays. The rocks and the rough ground which limit the bays may therefore be considered to act as barriers to migration.

Of the 61 plaice recovered only two made conspicuous migrations, and only seven may be said to have left the bays where they were liberated. The two just mentioned were liberated in Goswick Bay to the north of Holy Island on June 26th. One found its way to St. Andrew's Bay, where it was captured on November 5th, and the other was caught on May 27th this year seven to eight miles east of May Island. On the same day at 6.15 a.m. 14 other plaice were marked and liberated at Goswick Bay, and these were all taken from Skate Roads, south of Holy Island. Six were recovered, the two just mentioned, two at Goswick Bay, and two at Skate Roads. The latter are the only ones we have record of which offer us a hint at the homing instinct. As will be evident, however, the

position is very equally divided—two remaining where they were placed, two migrating to considerable distances to the north, and two returning to Skate Roads, it must be said, over or around an extensive area of rocky and rough bottom.

If note may be taken of the smaller migrations, it may be said that the majority inclined to go north, but we cannot overlook the fact that a certain number found their way to the south. And these results would lead us to suppose therefore that the attractions of the food supply lead to small migrations of the immature fish, but there is no evidence to prove that a definite migration of plaice occurs in the inshore waters of Northumberland. It is to be presumed therefore that the majority simply migrate outwards to the deeper water as they become mature. This is what has likely happened in the case of No. 879, but the locality of capture is not known. For the information I am able to furnish with regard to this and others which have left our district, I have to thank Mr. Garstang, Lowestoft Laboratory.

A consideration of the two which migrated so far into Scotch waters suggests, in the first place, that if such a migration is at all general it is not necessary for the immature plaice to go up the Forth to get to the north side; and shows in the second that it is only in the case of an approach to the locality which was the scene of the Scotch experiments that we get results strongly confirmatory of these.

We have so far recovered 61 of the plaice, or 13 per cent. This is a large number, but it will be seen that it would have been still greater if the proportion returned from some of the bays had not been so disappointing. In the case of Cambois Bay we marked 44 plaice, and did not recover one. Eighty-five were liberated in Alnmouth Bay, and only two were returned to us. We have been informed that the fishermen at Alnmouth captured a number of the marked plaice, but did not know where to send them. On the other hand Skate Roads yielded 20 per cent., Blyth Bay 15 per cent., and Druridge Bay 11 per cent.

Growth.—Attempts have frequently been made to state the rate of growth for plaice, and the want of conformity in the conclusions is no doubt due to the fact that there is a considerable degree of variation, brought about for the most part by the long spawning

period. The produce each year thus varies greatly in size, and during growth they are to some extent unequally affected by the successive seasons of acceleration and retardation. The various regions in which plaice occur are not equal either with regard to temperature and food. The variations in the seasons also leave more or less an impress on growth.

The most important recent work on the subject has been done by Fulton and by Apstein, and notwithstanding that the research was made in the one case on Scotch plaice, and in the other on the plaice of the Baltic, the conclusions are very much in accord.

During the last six years I have carefully measured the fish caught in the first haul at our trawling experiments, and in my last report I brought together the results so far as they related to the growth of the plaice. The experiment in migration now under consideration serves to confirm the determinations arrived at by an analysis of the plaice caught by the trawl. I do not propose to give now, however, the details in figures, nor the graphic consideration of these, which have led to the conclusions given in the following table :—

PLAICE.

Age.	Average Length.	Gain.	Average Weight.	Gain.	Proportional Rate of Growth in Weight.
Years.	Inches.	Inches.	Ounces.	Ounces.	
1	3·9	...	0·4	...	...
2	7·9	4·0	3	2·6	650
3	10·8	2·9	8	5	167
4	13	2·2	14·5	6·5	81
5	15	2	22·5	8	55
6	16·8	1·8	31·5	9	40
7	18·4	1·6	40	8·5	27
8	19·4	1	47	7	18
9	20·2	0·8	53	6	13
10	20·8	0·6	57	4	8

The earlier stages were determined from a consideration of a graphic analysis of the first haul, and of the results of the migration experiment.* I have ventured in bringing the results together to continue the curve, so as to be able to state approximately the

* In the 18th Ann. Rep. of the Liverpool Marine Biol. Comm., p. 37 (1904), it is stated that the 4-5 months old plaice kept in tanks were between 1½ and 2-in. in length. Only three of the 80 measured were over 3-in. long.

growth of the larger forms. The range of variation for the Northumberland plaice may be said to be at least two inches on each side of the line given as the mean rate of growth.

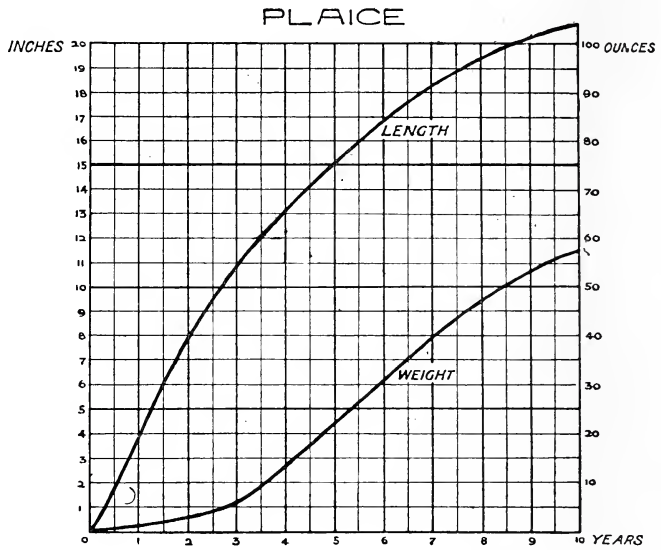


Fig. 1.—Diagram showing approximate average growth of plaice.

The season during which the trawling experiments are made is not a convenient one for an enquiry into the size at which maturity is reached, but each year I have examined a certain number of the plaice captured, and the smallest female which was noted to be mature was one of 14¾-in., but practically all above 16-in. were either mature or had from all appearances spawned. It is still more difficult to determine during the summer if the males are mature, but all above 14-in. appeared to be mature. It may be said then that the sexes reach maturity at 4 to 5 years. Fulton's conclusion that the males attain maturity at four and the females at five is evidently therefore very nearly if not quite accurate.

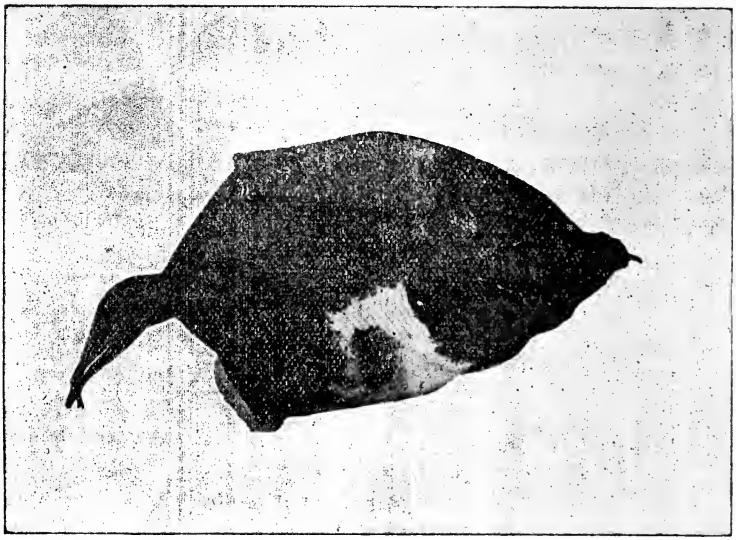
On the Northumberland coast, therefore, the small plaice of the sandy pools gradually pass out to the immediate slightly deeper waters of the bays, where they spend the immature phases of their lives, and do not migrate, so far as we can see, far along the coast. Approaching maturity impels them when 4 to 5 years old to

migrate into the deeper extra-territorial waters, and even there they appear to have the tendency to migrate into deeper and deeper water as they become older and larger. This in itself would serve to correct to some extent the general southerly and westerly movements of the ova and larvæ. Some of the mature plaice certainly do find their way back to the same or other inshore waters, impelled more than probably by recollections of sand eels, but such a return cannot be said to be more than rare.

But we look to the international researches to show if there is a distinct or even a general relationship between size and depth, and if this may be looked upon as the only impulse which tends to move the plaice in a definite direction in the North Sea.

Population.—Following a method which has been adopted before in the case of such experiments, a calculation may be offered to give an indication of the number of the resident population of plaice of from 2 to 4 years old. We marked 471, and we recovered from the catches of fishermen in the district 54. This is, allowing slightly for loss, one-eighth part, and may be taken therefore to represent approximately the catching power of the inshore fishermen. As near as we can gather the fishermen caught in the inshore waters for the year ending June 30th, 1904, 440 cwts. of plaice. The population of plaice of the inshore waters from about 7 to 14-in. long may be said to be therefore 3,520 cwts. If the average weight of the fish be, say ½-lb., the population in numbers is about 800,000. Considering the large proportion obtained from some of the districts this number will probably be found to err by being too large rather than too small. On the other hand, however, many more plaice are caught than are sent to market or used for crab bait; and as a matter of fact our labelled fish were sometimes caught by others than professed fishermen.

Pathology.—Several plaice were marked which were abnormal as to colour, and one of these, No. 818, was re-captured and forwarded to me. When caught it had a rectangular white patch with a central spot of pigment on the upper side near the ventral fin, and the label was attached near the edge of the spot to mark its position. When it was sent to me, after a free period of 288 days, it still presented the patch and the central spot, so far as I could see, unchanged either in area or appearance. It was a male, and its abnormal colour did not have any effect upon its rate of growth.



Abnormally coloured Plaice, No. 818.

2.—MIGRATIONS OF THE DAB.

The common dab is, as has been apparent from the trawling experiments, an important member of the flat fish fauna of the inshore waters, rivalling the plaice, in fact, in the southern sandy stretches for predominance.

The previous experiments of Fulton* showed that the dab migrated to a larger extent than the plaice, but the results did not point to any definite direction being followed, and no details were furnished as to the sex of the recaptured fish.

The accompanying table (page 74) exhibits the results of our experiments with reference to the migration of this form to the end of the year. The returns are too few to lay any stress upon, but it must be pointed out that the females show a tendency to remain in the district, while the males, in the case of the two which have been recovered have migrated to a considerable distance to the south, and into deep water.

A labelled dab was captured E. by N. of Souter Point on 12th October, but the numbered portion of the label was lost by the fisherman. The dab measured 6 inches but the sex was not stated. In the light of the other results, there is every probability it was a male.

* Op. Cit. p. 187.

CONFERENCES WITH FISHERMEN.

Arrangements were made through the Educational Committee of the County Council for the delivery of a lecture at several of the fishing stations on the Crab and Lobster Fisheries, when the facts set forth in the paper on that subject in this report were presented and discussed.

The fishermen confirmed the conclusions which had been arrived at with reference to the proportions of the berried crabs and lobsters, and in many cases of the soft crabs. They are thus prepared to admit the importance of the berried lobster, but in most places they are desirous of having lobster culture tried, if only to avoid the immense sacrifice that the returning of the berried lobster entails. It was confessed that the practice of stripping the berried lobster so that it could be marketed was quite common.

A matter of great moment for the improvement of the conditions of the inshore fisheries is the supply of bait. This was pointed out in the preceding and in previous reports. The Budle Bay Mussel Farm is now in the hands of Mr. Mitchell, who also keeps for sale a supply of oysters in the pond which was built some years ago for the purpose. The mussel farm, however, is not at present in a very successful condition, and as a matter of fact all that was available for sale for bait was 6 tons. The question of bait deserves the most serious attention of the Committee, and thorough enquiry should be made without delay to find out the cause or causes of the diminution of the local supplies, and what could be done to improve them.

A PRELIMINARY NOTE ON A TREMATODE PARASITE IN *CARDIUM EDULE*.

By M. V. LEBOUR, B.Sc.

Early in October, 1904, I examined about 20 cockles (*Cardium edule*) from Budle Bay, Northumberland, and among them found one which had its foot covered with small tubercles, and another similarly but more slightly affected. On microscopic examination the tubercles proved to be encysted Trematode worms.

Afterwards, in November, on examining a large quantity of cockles from the same locality I found about 10 per cent. had the the worms in the foot, but many more (about 75 per cent.) on microscopic examination were found to have a Trematode in the sporocyst stage round about the intestine and in the liver. All those that had the foot affected also had the sporocyst form, but many had the sporocysts without the worms in the foot. Mr. Shipley to whom I submitted the worms from the foot regards them as belonging to the genus Distoma and the sub-genus Echinostoma. As the sporocysts are evidently also a species of Distoma, they are probably the sporocyst stage of the encysted worms in the foot.

The cockles are fine specimens, often 45 to 50 mm. in length, and, it may be added, vary much in form.

The worms are enclosed in cysts inside the tissue of the foot, and can be teased out complete still enveloped in the cysts. On gently pressing one of these the worm may be squeezed out. The only successful method of mounting them appears to be in dilute glycerine; glycerine jelly and Canada balsam both spoiling the appearance of the creature and often breaking it up.

Thus disclosed (see Plate, fig. C) the worm is elongated, transparent, and granular. One end is broadly heart shaped and surrounded by long straight spines. At the very anterior end is a sucker and further back but still in the region of the spines is an opening

bordered apparently by two thick lips, but this could not be very plainly seen. This opening seems to lead to an obscure alimentary canal. Further back than this is a still larger median sucker. The whole surface of the body is covered with small hook like spines. Down each side in some specimens a branched bead-like structure can be made out.

The sporocyst (see Plate, figs. A and B) is oval, pointed at one extremity, with two conspicuous black eyes, the other end is rounded and the whole body is covered with cilia which are constantly in motion in the living animal. The sporocyst may contain three different elements, (1) spherical masses full of smaller spheres, (2) the same but with two of these masses in one envelope, (3) minute sporocysts exactly like itself and containing small spheres.

These are not generally all present at the same time, the first two being found together without any of the minute sporocysts which latter are usually found alone almost filling the body of the parent, one or two of the large double spherical bodies being sometimes present. The small sporocysts burst out of the side of the parent and stream out, moving about slowly, and soon get separated from one another.

Apparently there is nothing special about the shells of the cockles that contain these parasites. One measured 44 mm. across, its organs seemed to be in a healthy condition but were not investigated closely.

Sections of an affected foot were cut and stained but the sections were not successful so far as the parasite is concerned. The cysts showed a thick wall staining deeply. The tissues of the foot round about the cyst were greatly modified, staining much more deeply than the natural tissues, giving signs of having arisen through considerable cell multiplication.

So far I have not discovered a cercaria stage. The specimens do not appear to contain them. Possibly it may not be the right time of year for them. I hope also to be able to discover the adult stage in some fish or sea bird.

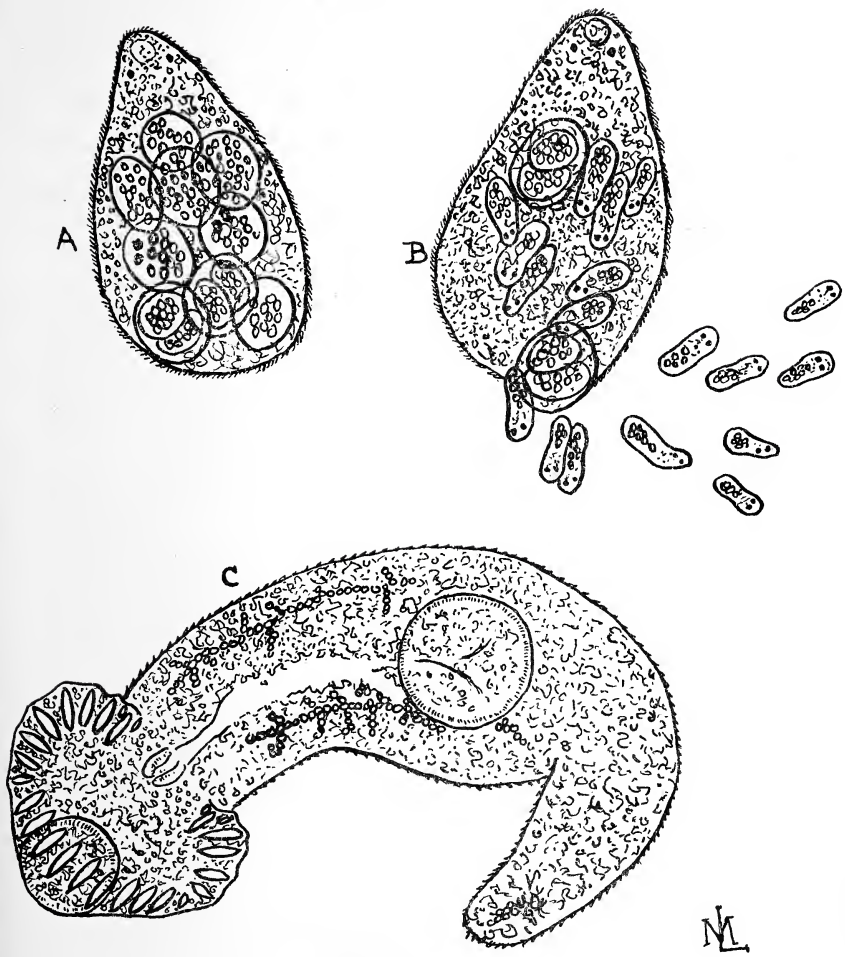
The following is a table showing the numbers of sporocysts in 20 cockles, the intestines and livers of which were carefully examined. It will be seen that 6 had apparently no worms in them nor sporocysts, 10 had no worms in the foot but had sporocysts, and 4 had both. Of the 14 cases in which sporocysts were present,

13 exhibited them in the liver; in one case as many as 6 were found. In another there seemed to be none in the liver but one outside the intestine, in 7 cases the sporocysts occured in the liver only. In no case were there any worms in the foot and no sporocysts in the liver or round the intestine. Evidently the liver is the favourite place for the sporocyst.

Cockles.	Worms in Foot.	Sporocysts round intestine.	Sporocysts in Liver.
1	Many.	1	
2		1	3
3			6
4			1
5			1
6			
7	Many.		1
8	Many.		3
9			2
10		2	1
11		3 in region of ovary.	1
12			1
13			
14			5
15			
16			
17			1
18			3
19			
20			

Since writing this I have discovered another stage of the worm in the liver of the cockle, of which particulars will be given later.

M. V. L.



Trematode Parasite in Cardium.—

A. and *B.* Sporocyst Stage × 400.

C. Stage in Foot × 1,400.

ADDITIONS TO THE LIST OF THE MARINE MOLLUSCA OF NORTHUMBERLAND.

By M. V. LEBOUR, B.Sc.

The following are additions to our list, although all have been recorded by Alder.

GASTEROPOPA.

Family *Chitonidæ.*

Chiton ruber (L).—Common at very low water under stones, Newbiggin.

Chiton fascicularis, L.—A few specimens under stones among Lamellaria at very low water, Newbiggin.

Family *Littorinidæ.*

Lacuna puteolus, Turton.—Common on Lamellaria, Newbiggin.

Littorina neritoides, L.—Common on the rocks, Newbiggin.

Family *Velutinidæ.*

Velutina lævigata, Pen.—Two dead specimens on the beach, Bamburgh.

Family *Aplysidæ.*

Aplysia punctata, Cuv.—This year several specimens were obtained at Newbiggin and Cullercoats.

Family *Doridæ.*

Doris repanda, Alder and Hancock.—Abundant on the Church Rocks, Newbiggin, which is one of the two localities mentioned by Alder. They are to be found in deep pools, which are only uncovered by the spring tides.

Family *Polyceridæ.*

Polycera quadrilineata, Müller.—Several on the cement bags, uncovered at spring tides, Newbiggin, with *Doris bilamellata.*

FAUNISTIC NOTES.

By ALEXANDER MEEK, M.Sc.

1.—A John Dory, *Zeus faber*, was caught at the mouth of the Blyth on 15th April, and forwarded by Mr. Gibbon.

2.—Mr. Arnett has informed me that a large Grayling was caught in the Blyth in June. I have not heard that Grayling have been introduced into this river.

3.—A Porpoise, or at all events from the description what was evidently a Porpoise, measuring 8 feet, was caught in the salmon nets off Cullercoats on August 18th.

4.—A large Thresher, *Alopias vulpes*, was similarly caught in the salmon nets off Cullercoats on August 19th.

5.—A seal, measuring 3½ feet, was got while asleep on the Tynemouth sands close to high water mark one day in August.

6.—A King Fish was captured off the Tyne by a trawler about the end of August. It was about 2½ feet long. But probably more examples than this have been caught and landed during the year.

7.—On October 11th a Bass, *Morone labrax*, was captured in the trawl off Newbiggin in 34 fathoms, and forwarded by Captain Cappelman. It measured 20¼ inches.

8.—I have to thank Captain Cappelman also for a specimen of the Sting Ray, *Trygon pastinaca*, captured end of October S. E. by E. of the Tyne in 40 fathoms, and for (9) an example of the variety of the Norway Haddock, *Sebastes norvegicus var. viviparus*, obtained 31st October 6 miles off Dunstanburgh. This form was previously recorded by Howse from 150 miles off the Tyne.

10.—On 5th December a young male Porbeagle Shark, *Lamna cornubica*, measuring 3 feet 2 inches, was sent to the Hancock Museum by Mr. L. Steel, and the Curator was kind enough to send me the specimen. It proved to be interesting because of its graceful shape, the length being much greater in proportion to the depth than in the adult condition. The colour moreover was blue above. Small spiracles were present, each a little in advance of the mid distance between the orbit and the first gill. I am obliged to Mr. Boulenger for confirming the determination of the species.

11.—On the 9th December, Mr. Steel sent me a fine Monk Fish, *Rhina squatina*, a female measuring 3 feet 3 inches. The only peculiarities it presented were (1) the small eyes, these only measuring half the distance from the orbit to the spiracle; (2) the dorsal spines, which were not at all prominent.

12.—In June a female lobster was brought by Fishery Officer Buglass from Sea Houses, which had more than 20 mussels attached under the abdomen. The latter measured 1 to $2\frac{1}{2}$ cm. The lobster also gave lodgment to Anomia between the pereiopods and elsewhere, small tubes of Serpula, large colonies of Membranipora, and 2 or 3 Barnacles.

The length of the lobster was $13\frac{1}{4}$ inches, and that of the ovary $6\frac{1}{2}$ inches; the ova were small. It was evidently going to cast, for the cuticle was completely separated except at the joints from the newly-formed cuticle. It is clear, however, that it could not have cast during the previous 2 or 3 years. It may be stated that female crabs are sometimes obtained with the abdomen distended by mussels attached there or to the thorax or both.

As we now know that a considerable interval may elapse between the casting and the spawning period it is obvious that such a lodgment would prevent the ova being attached under the abdomen.